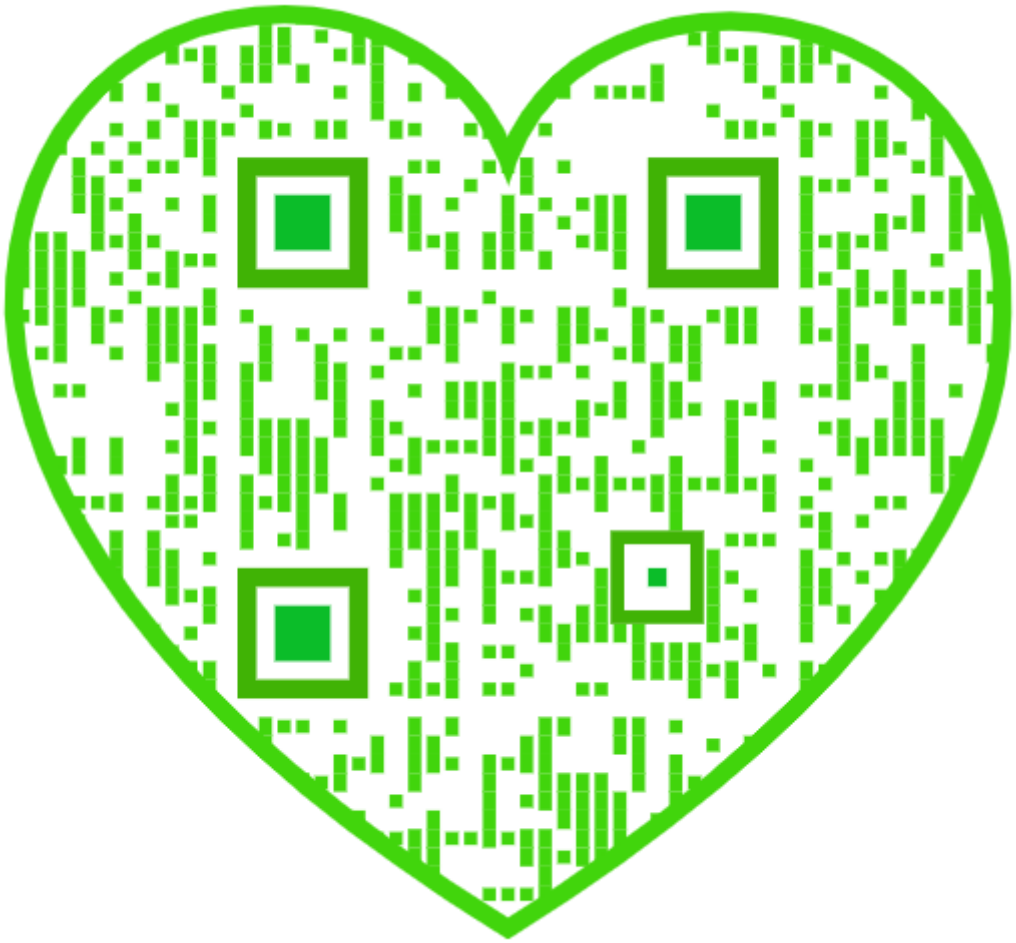
FARM ANIMALS

E. V. WILCOX



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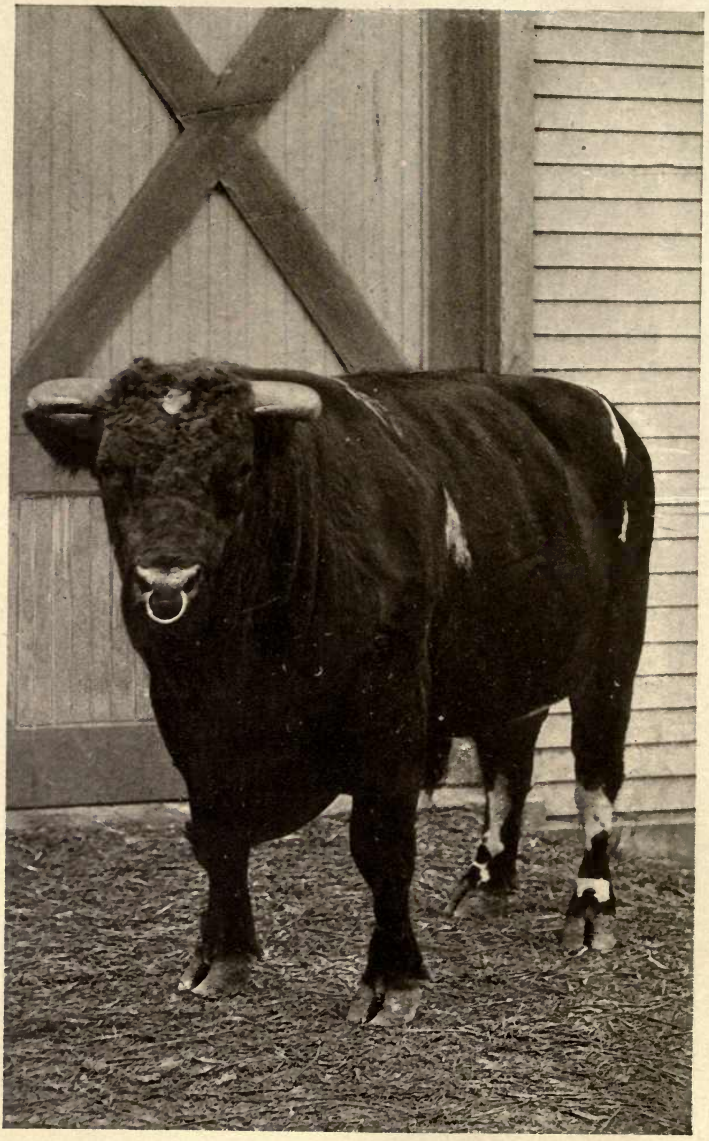

SHORTHORN BULL—THE POPULAR BEEF BREED.

The Farm Library

FARM ANIMALS

Horses, Cows, Sheep, Swine, Goats, Poultry, Etc.

By E. V. WILCOX, Ph.D., A.M.
U. S. Department of Agriculture

NEW YORK
Doubleday, Page & Company
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CHAPTER I.

THE HORSE

The horse has been recognized as man's most intimate animal friend and notwithstanding that it has not been under domestication so long as some other animals it is at present associated with man by more points of sympathy than any other of our domestic animals. Geologists have shown that the original ancestors of the horse occurred in America in past ages but that these were all exterminated by some climatic or other unknown cause and that our present horses are all descended from old world horses which in turn are derived from the original geological ancestor of the horse in America. It has recently become fashionable with certain writers to refer to the waning importance of horses and to use such phrases as the "horseless age" and others which indicate that the horse is gradually losing his claim of service upon man. In view of such misinformation it seems desirable to state that the horse was never in greater favor than to-day. The number of horses in the United States is increasing rapidly, more interest is being everywhere manifested regarding their care and

management, and more appreciation of the horse is shown in protecting him from annoyance, overwork, exposure, and disease. Formerly the quack horse doctor was able to make as much money as the qualified veterinarian and in many cases his services were taken in preference to those of the latter. This was largely due to the relative cheapness of the horse and the slight esteem in which this animal was held. Within recent years veterinarians everywhere have observed the increased respect paid by horse owners to their animals. Owners are not only willing to pay more liberally for professional services but give more personal attention to the study of the necessary hygienic conditions for horses and to the simple diseases which may yield to home treatment. The horse is more than holding its own with the automobile and thus the predictions of the automobile enthusiasts have entirely failed to come true.

Horses are required on the farm for saddle purposes, driving and ordinary farm work although on more extensive farms with various lines of industry there may be required some more detailed classifications of their usefulness. Horses are not raised exclusively for farm work, however, and farmers who wish to breed horses for sale must first acquaint themselves with the requirements of the market along this line. In general two types of horses are recognized on the market, namely the draft and light types. These two types are essentially different from each other. The draft horse is heavy of body and the length of the body is relatively much shorter than in the light type. The only use of the draft horse is to haul loads of greater or less weight, usually

at a slow gait. The gait, however, depends somewhat on the size of the draft horse and the purpose to which he is put. The draft horse proper, as a recognized market class, should stand about 16 hands high. From a mechanical standpoint the limit of height of such horse should be 17.3 hands since exceptionally tall draft horses are usually weak in some other points of their conformation. The light type of draft horse may range from 15.3 to 16.2 hands. The draft horse should weigh at least 1000 pounds and for heavy use each additional 100 pounds they weigh will add nearly $25 to the value of the horse. The weight limit is not a definite matter and for certain uses the heavier the horse the better. According to Alexander a grade Shire gelding weighing 2210 pounds brought $660 on the Chicago market in 1904. Draft horses should show comparatively short legs, smooth form without angularity, strong legs with wide hocks and knee joints, and regular, sloping pasterns. The walking gait is the most important gait of the draft horse and should be a rapid stride with straight leg movement, that is, all the legs should move forward in a straight line and should not show any lateral movement or waddling.

From the class of drafters there are many culls or defective specimens which go to make up other poorly defined classes. For example, lumbermen require a draft horse of great strength but since these horses are used in the woods slight blemishes do not count much against their value provided they do not interfere with the work or action of the horse. The draft horse therefore with good strength and good points but slightly blemished may be sold to lumbermen as loggers. Such

horses must show strength and if possible a firm, muscular structure. Recently as shown by Alexander the lumbermen have found it advisable to buy logging horses from the producers rather than after they have been over-fattened and made blubbery by the feeders on the stock markets. This class of horse may be expected to bring about $150 to $250 per head whereas draft horses without blemish should bring from $350 to $500.

Draft horses of mixed type and mixed breed and somewhat under weight are sometimes grouped together in the class known as farm chunks. These horses may be found on the market in large numbers and sell for $90 to $175 per head. As a rule they stand 15 hands or more high and weigh from 1200 to 1500 pounds. They are among the heaviest of the light type of draft horse but on account of their character and low price are extremely unsatisfactory horses for the farmer to market. Approaching to the general type of draft horse we find the market class known as express horses which are draft horses standing 15.3 to 16 hands high and weighing from 1350 to 1600 pounds. This class of horses must have the general conformation of the draft horse so far as deep bodies are concerned but must stand higher on the legs, show more grace and better gait, cleaner legs with somewhat smaller joints, and less feather in the case of grades from breeds which carry a heavy feather on the leg. These horses are sometimes described as draft horses with a cart horse finish and it is necessary that they be able to move moderately heavy loads at a brisk walk or even a trot. Such horses bring about $25 more than farm chunks. Various other classes are occasionally

Photograph furnished by C. C. Glenn.

BLACK AND GRAY PERCHERONS — THE FAVOURITE DRAFT HORSE.

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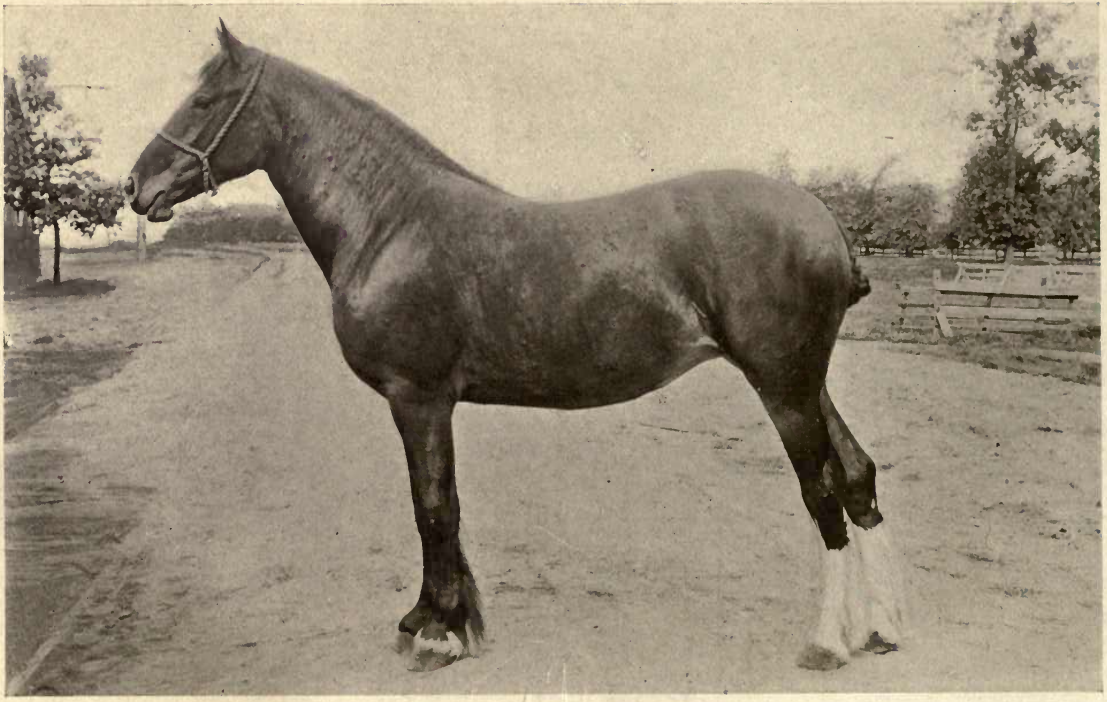

Courtesy of University of Wisconsin, College of Agriculture.

A YOUNG PURE BRED CLYDESDALE FILLY — THE HORSE WITH THE LONG STRIDE.

recognized on the market, approaching the general type of the draft horse. The call for such horses is less frequent than for the recognized classes and the farmer is therefore not justified in attempting to raise horses to fit this class. These draft classes are known as bus horses, tram horses, artillery horses, van horses, cart horses, etc. Some of these are shipped to England and other parts of Europe for use in hauling heavy busses and public street vehicles. In this country such horses are most commonly drawn from the other standard market classes.

The general term driving horse includes a considerable variety of types which differ in height, strength, and gait. The typical driving horse should stand from 15.1 to 15.3 hands high and weigh from 1000 to 1150 pounds. The business of the driving horse is to pull a light vehicle at a comparatively rapid stride and for a considerable period. Such horses in order to bring remunerative prices must be graceful in form, symmetrical, smooth, sound, with clean legs and with fine heads. It is quite useless for the farmer to expect any profit in breeding driving horses for market so long as they do not please the eye in every respect and show more than the average speed and graceful gait. The market is always overloaded with poor or medium driving horses and it is impossible to get enough from this type of horse to pay for raising them. The coach horse stands about 15.3 to 16 hands high and weighs from 1050 to 1250 pounds. This horse is slightly heavier than the true driving type, should show correspondingly larger body and must show if anything a smoother form and otherwise the general conformation of the roadster.

The chief characteristic is its gait which must be high without stopping the movement of the feet, and the knees and hock must be strongly flexed in action. Evidently it is impossible to expect a horse to show high knee and hock action and at the same time great speed. Coach horses which can show a speed of from 6 to 10 miles an hour are quite satisfactory. The knee action however must be up to the standard and in driving the knee should be flexed so decidedly that the feet describe an almost perfect circle in their motion without coming to a decided stop at any point. The coach horse must also show style and legs of good form and action, otherwise the price will be unsatisfactory. For the proper coach type about $475 to $500 per head is the price on the Chicago market.

The cob horse is a special type of coach horse of small size and light weight, 1000 to 1050 pounds. This horse is used commonly as a single driver or in tandem, must possess very high action of the knee and hock and must show a rather more compact, blocky form than the coach horse, with all of the style of the latter.

The saddle horse naturally varies considerably in weight to accommodate the difference in weight of the intending buyers. The height varies from 15.1 to 15.3 hands and the weight from 1000 to 1200 pounds. This type of horse is essentially that of the trotter or thoroughbred with slightly more muscular build. The conformation must be smooth, shoulders and pasterns sloping, withers moderately high and narrow and the back strong and muscular. The saddle horse in order to bring a satisfactory price must be gaited, that is must be able to assume at com-

mand one or the other of at least five gaits, including walk, trot, canter, running walk, and rack, slow pace or fox trot.

The horse market also makes a considerable demand for standard bred trotters, wagon horses, polo ponies, hunters, fire horses, police horses, and horses for other special purposes. As already indicated, however, the farmer who wishes to make a reasonable profit in raising horses for market must first study carefully the demands for various classes of horses on his home market, the exact standards required for these classes and must then proceed to carry on his breeding work so as to obtain the desired results. It is useless to raise nondescript horses or horses which do not fulfill the requirements of some recognized class. This is self-evident since the nondescript horse is so called because it cannot be described, therefore cannot be entered in a definite class and will obviously not be called for by buyers.

There are certain points in the conformation of horses which it may be well to bear in mind. In the thoroughbred or racing type the height at the withers and also at the croup should be the same and equal or greater than the length of the body while the depth of the body at the withers should be considerably less than half the height. In saddle horses, hunters, steeplechasers or any other horse where speed is required the shoulders should be sloping. This point in the conformation is necessary if the horse is to take long or sustained strides. In horses where the shoulder blade occupies an approximately vertical position the speed is necessarily handicapped by this fact. In both the light

horse and the heavy horse type the knees and the hocks should be relatively large, for great strength is required at these points and too small joints are an indication of weakness. In the heavy horse type the legs are as large and strong as is compatible with quality. There should be no tendency towards coarseness or sponginess of the legs. The length of the body in this type should be considerably greater than the height at the withers. On account of the extreme muscular development in the shoulders of draft horses the relative length of the head may be less than in speed horses.

In breeding horses it is desirable to take into consideration some of the effects of climate and soil on the conformation of the horse. It is a fact of general observation that horses reach their greatest height in temperate climates and diminish in size both in the cold and hot climates. Great altitude has the effect of reducing the size of the horse somewhat but may simultaneously add considerably to the hardiness and relative power of the horse. The effect of the varying humidity of the air in different regions is not very striking in temperate climates. Excessive moisture, however, may predispose horses to the disease known as roaring. The quality of the pasture exerts a rather striking influence on the development of the horse. Thus we have the blue grass horses of Kentucky pastured on the blue grass of that state, the long suffering and indefatigable broncho reared on the nutritious range grasses of the mountain pastures and various other geographical varieties of this sort. Moreover the heavy draft type develops best on low lying pastures while the light horse in-

tended for speed is a native of higher ground well drained and without an excess of moisture. Speed and strength of horses as well as the legs and bones are to a considerable extent influenced by the soil conditions since lime and various other minerals are known to be necessary in the proper nutrition of all animals. Where these mineral matters are absent from the soil they naturally exist in a low percentage in the plants grown on such soils and various bone diseases may result in horses and other domestic animals pastured on such grasses. At any rate it is impossible to secure the proper strength and toughness of bone without having the right geological conditions of the soil.

BREEDS OF HORSES

Breeds of horses, like breeds in any other domestic animals, are groups of closely related individuals having a common ancestor and showing a number of characteristic points in common by which they may be classed together and described by a common set of terms. The horse has developed along two common lines, viz. the draft type and the speed horse, and these two types are in turn subdivided into a number of distinct breeds each of which traces its ancestry back in a more or less pure line for many years and some of them for several centuries. The two types of horses from which our modern breeds have descended come from different localities in which the soil conditions were entirely unlike. The modern Thoroughbred is the latest development of the so-called Oriental horse which developed in various forms in Africa, parts of Asia, Spain, and was finally

brought to its present perfection in England. The modern Thoroughbred is the first form which breeders have developed; but a number of other breeds, each having stud books and separate standards for registry, have been developed from the same source. These breeds are the Trotter, American Saddle Horse, French Coach, German Coach, Hackney, Cleveland Bay, Morgan Horse, and various breeds of ponies.

On the other hand a low, heavily built horse, with comparatively large feet and limbs developed and spread over a considerable portion of Europe, especially the northern, low lying sections, and from this old black horse of Europe or the Black Horse of Flanders as it is variously called, all of our modern draft horses have been produced by selection, careful breeding, and a mixture of other strains of blood. These breeds include the Percheron, Clydesdale, Shire Horse, Suffolk, French Draft and Belgian Draft. In the following paragraphs we shall give the characteristics of the different breeds, beginning with the draft horse as being peculiarly suitable for breeding on the farm.

Percheron.—This breed of horse is unquestionably the most popular of all the drafters. It was developed in France in the district of Perche and is to be considered as the national French horse. Two forms of the Percheron were developed first, one of which was a comparatively light horse used for coach purposes, while the second was the heavy draft type which is preferred in America. The Percheron was introduced into America about 50 years ago. It is a massive, heavily muscled horse, standing 16 to 17.2 hands high and weighing from 1600 to 2200 pounds or more. The Percheron is known throughout the country for his character-

istic gray color but black is now coming into fashion and bays and roans are common with an occasional brown or chestnut. The head of the Percheron is small compared with the size of the body, the neck is well arched, the hind quarters broad and muscular, and the legs short with very little "feather." The action of the Percheron is good but the stride is not so showy nor quite so active as that of the Clydesdale. Occasionally there is a tendency in Percherons to develop a chest so wide that the stride becomes a rolling or waddling gait. Percherons are used very extensively on farms, especially in the Middle West for producing grade draft horses from native mares. At present there are more than 30,000 registered Percheron horses in the United States.

Clydesdale.—This draft horse originated in Scotland by improvement from the old black horse of Europe, the foundation stock being imported into Scotland early in the 18th century. At present the prevailing colors of the Clydesdale are brown, bay, or black, with white markings on the face and legs. The Clydesdale stands from 16 to 17 hands high and weighs from 1600 to 2200 pounds. The head of the Clydesdale is long, usually with a straight but sometimes with a Roman nose. The back is sometimes a little too long but the hindquarters are splendidly covered with muscle and the feet and legs are perhaps as well formed as in any breed of draft animals. The legs are clean with a slight feather which springs from the back tendons and not from the sides of the leg as in the Shire horse. In some cases the leg bones are somewhat too light but the defects in the breed are being corrected by special attention given to these points. The characteristic feature of the Clydesdale is his long

stride and rapid walk which is particularly desirable in a draft horse.

Shire Horse.—The Shire horse, also known in the early days of England as the "great horse" or "war horse," is quite closely related to the Clydesdale in its early development into a distinct breed. This horse has recently become popular in the United States. The prevailing colors are bay, brown, black, and gray. In height they somewhat exceed the Clydesdale and the weight is also somewhat greater. The Shire horse usually has a Roman nose, short neck, straight shoulder, broad back, short loins, and strong legs with a heavy feather springing not only from the back tendons but also from the sides. The legs show a tendency to coarseness in some individuals and the walk is slower than that of the Clydesdale.

Suffolk.—This breed of draft horses, also known as the Suffolk Punch, originated in England and has been developed from an early date with especial reference to its use on the farm. The Suffolk is almost always some shade of chestnut or sorrel, a bright chestnut being preferred. Occasionally bays are seen; but any color other than chestnut or sorrel is looked upon as evidence of impure blood. The body of the Suffolk horse is well rounded, the legs are clean, and the action brisk. The Suffolk is not as large as the Clydesdale or Shire horses, standing 15.3 to 17 hands high and weighing from 1500 to 2000 pounds. This breed is not extensively used in the United States as yet.

French Draft Horse.—This breed of drafters originated in Northern France. The prevailing colors are gray, bay or black. French drafters are among the heaviest of horses, weighing up to 2200 pounds or more and standing 16 hands high or

more. They are a particularly massive horse on strong legs with light feather. In the early days it was not kept distinct from the Percheron but at present no admixtures of blood are allowed in registered horses of this breed. On account of the impure ancestry of the horse it does not breed so true as other horses which have been kept pure in their descent.

Belgian Draft Horse.—This may be considered as a typical development of the old black horse of Flanders with its tendency to great size and strong legs sharply accentuated in its modern representative. The Belgian draft horse has not been imported in large numbers into the United States until recently but the breed is rapidly increasing in popularity. The first importation of this breed was severely criticized for their heavy, thick legs, coarse bone, and lack of quality in general. Recently, however, they show a marked improvement in these respects. In conformation they are heavier than the Percheron, somewhat shorter on the leg, with heavier head, ears less erect, sometimes with a tendency to droop. This is the giant among horses and weighs from 1700 to 2500 pounds or more and stands from 15.3 to 17 hands high.

Thoroughbred.—The Thoroughbred is the oldest breed of horses with an authentic pedigree. The early history of this breed shows conclusively that it was formed from importations of Oriental horses of various sorts, including Barbs, Spanish, African and Turkish horses. The name of the breed deserves brief attention since it is anomalous in the respect that it is not a characteristic breed name. On account of the fact that the Thoroughbred was the first breed of horses to be definitely established this horse came to be known as the Thoroughbred

in contrast to other horses which were half-breeds or mongrels. The name has persisted so that at present the term Thoroughbred should be applied only to the pure breed of race horses originated in England and later transplanted to the United States and various other countries. In the numerous books and less extensive articles which have been written on this horse, a considerable percentage of writers have extolled in glowing terms the Arabian horse and have traced nearly all of the speed, life and endurance of the Thoroughbred to its Arabian blood. Investigations of this matter, however, show that the Arabs originally used camels and were entirely unacquainted with horses until at least as late as the 3rd century of the Christian era. Modern investigators have found that the Arabs are not very excellent horse breeders and recent importations of Arab horses have in all cases proved inferior to the Thoroughbred both in speed and endurance. The credit for establishing the Thoroughbred must therefore be given chiefly to English breeders rather than to the more or less fabulous speed of the Arab horse. The color of the Thoroughbred is brown, bay or chestnut with a blaze on the forehead, or white feet. The breed, as is well known, is racy in build with a tendency to angularity, long slender legs, long neck carried not high above the withers, strong back and hindquarters, which, however, are somewhat drooping.

The American Trotter.—This breed, as indicated above, is based on the Thoroughbred, as are all other horses showing unusual speed. The foundation horse to which the best of American trotters trace their ancestry was known by the name of Messenger, a Thoroughbred. Various modifica-

tions of form have been made by American breeders, special attention being paid to the development of a rapid stride. The Thoroughbred blood appears in the speediness and endurance of the Trotter. Both Thoroughbreds and American Trotters may show both the pacing and the trotting gait. Since our point of view is that of the usefulness of the horse to the farmer we may pass on without a lengthy description of famous trotters. These matters belong less to the province of the farmer than to that of the typical horseman. The speed of these horses has been greatly increased until it has come inside of two minutes. At the present time the number of standard bred Trotting stallions in the United States is nearly 30,000.

The Morgan Horse.—This breed was developed from a horse of this name owned by a man of the same name in West Springfield, Mass. The Morgans were more favorably known in the last century than at present but within recent years a considerable revival of interest in the breed has taken place. The chief controversy regarding this horse, which is essentially a trotter, is concerning its ancestry, which has been frequently called in question. The original line has been mixed with Narragansett pacers and has developed a number of famous horses such as Black Hawk and Ethan Allen.

The American Saddle Horse.—This is another breed of horses developed in America especially among the pioneers of Virginia, Kentucky, and Tennessee. The early settlers took great interest in horses bred particularly for the purpose of producing saddle animals of endurance and speed. Their business required the use of such horses and great improvements were made along this line

before a breed could be said to be definitely established. The foundation stallion is usually considered to be Denmark, a Thoroughbred. This animal was brought into Kentucky in the year 1839. The American Saddle Horse has inherited its spirit and endurance from the Thoroughbred but the nervousness of the Thoroughbred has been eliminated. In order to be registered in the American Saddle Horse stud book the horse must be able to show five gaits, walk, rack, trot, canter, and either the running walk, fox trot, or slow pace. The American Saddle Horse stands about 15.2 high and is of various colors, being brown, black, or chestnut, and many of them are valuable for either saddle or harness purposes. Some saddle horses have developed a trotting gait somewhat better than 2.30.

Hackney.—The Hackney originated in England from good native driving mares bred to Thoroughbred stallions. The term Hackney is derived from hack, originally meaning any horse which was suitable for hauling comparatively light vehicles at considerable speed. The modern Hackney has been developed into a heavy harness horse of great style. His speed is not great since more attention has recently been given to the development of the walking gait with a high knee action. The form of the horse has become smoother and rounder than that of the Trotter with less tendency to angularity. The height ranges from 14.2 to 15.3 hands. In the movement of the legs the Hackney closely resembles the coach horse. The legs are greatly flexed and the knees raised to an extreme height and in motion the foot describes a circle. The chief faults of the Hackney from a farmer's standpoint is that his size is too small as a sire of work horses and his speed and

endurance are not equal to that of the standard bred Trotters as a sire to driving animals. In fact the Hackney and Coach horses are chiefly useful as park animals and for driving in boulevards where style and not speed is required. On the western ranges a number of Hackney stallions have been introduced for crossing on broncho mares but the results of these experiments cannot yet be stated with much confidence.

French Coach Horse.—This breed is the direct result of government enterprise in France. The French government felt the need of remounts for cavalry purposes and imported Thoroughbred stallions for crossing on native mares. On account of the repeated use of Thoroughbred stallions the French Coach Horses are still in many cases half-breeds rather than a pure breed. The faults of this breed are that it does not come true to color or type on account of the many admixtures of blood which have taken place. The action of the horse, however, in good specimens, is about equal to that of the Hackney or other coach horses.

German Coach Horse.—This breed originated in northern Germany and showed a number of different forms in different provinces, some of which have been recognized as distinct breeds. The best known type of the German Coach horse is the Oldenburg, which, like the French Coach horse, was taken up by the German government for the purpose of improvement. Like the French Coach horse also it was bred originally for cavalry purposes. The German Coach horse stands about 15.2 to 16 hands high and weighs from 1000 to 1200 pounds. The prevailing color is bay or brown. The action of the German Coach horse is somewhat less showy and artificial than that of the Hackney.

Cleveland Bay.—This breed originated in England and was in the early days used chiefly as a coach horse. It stands 16 to 16.2 hands high and weighs from 1100 to 1300 pounds. This breed has been introduced into the United States to a considerable extent and on account of its size and speed is recognized as an excellent horse not only for farm work but also for driving purposes, particularly as heavy harness horses.

Ponies.—A great variety of ponies has been produced in England as well as in the north of Scotland. Some of these ponies have been bred in sufficiently pure lines to lead to the formation of breeds. Perhaps the best known pony is the Shetland which came originally from the Shetland Islands. This pony is extremely hardy and the imported specimens show rather long and wavy hair. Typical specimens stand from 9 to 10.2 hands high and weigh from 273 to 500 pounds. The color varies but perhaps bays, browns, chestnuts and blacks prevail. The form of the Shetland is that of a heavy harness horse or sometimes that of a draft horse in miniature. Originally these ponies were used as pack animals and mine horses but at present they are used almost exclusively as children's pets. Various other breeds have been introduced from England such as Exmoor, Dartmoor, New Forest and Welch ponies.

On our western ranges the prevalent type of horse is also a pony known by various names such as mustang, broncho and cayuse. This horse is of Spanish origin and therefore of Oriental blood. The relationship to the Thoroughbred is also shown by its marvelous endurance and considerable speed. The modern broncho is used as a mine horse, for driving purposes, and as a saddle or pack

animal. Some of them are still practically wild and considered a nuisance. Until recently they were from time to time rounded up and shipped to a horse abattoir where they were slaughtered and the meat sent to Denmark and other parts of Europe. The broncho is capable of carrying a man and heavy saddle from 40 to 80 miles a day, is sure footed and a good rustler but frequently of bad disposition and ugly form. Recently a number of experiments have been made in crossing pure bred stallions of various breeds to broncho mares. Thus Thoroughbred stallions have been found very valuable as sources of polo ponies from broncho mares. In fact some of the ponies of the western ranges make excellent polo ponies without any admixture of other blood.

BREEDING HORSES ON THE FARM

As is indicated in the foregoing discussion of breeds and market classes the individual farmer will select that breed for which he has the greatest liking and will attempt to produce horses adapted for use on the farm or such as will conform to some market class. Many terms are in constant use in the literature of breeding and some of them may well be referred to in this connection. It is often said that heredity or the tendency of an animal to transmit its characteristics to offspring is the cornerstone of breeding. This is quite true from one standpoint but from another standpoint variation is equally if not more important. Every one knows that the progeny of the same parents are not exactly alike. They may easily be recognized by certain differences. This tendency to be unlike in certain respects is known as variation. It

is evident that were it not for the tendency towards variation it would be impossible to improve upon native stock or upon our present breeds to any great extent. Variation furnishes suggestions of valuable tendencies, which after being noticed are seized upon and perpetuated through heredity. In breeding animals the tendency is sometimes observed in offspring to "throw back" or to develop characteristics which do not appear in the parents but rather in grandparents or some other more remote ancestor. This is known as atavism and sometimes interferes to a slight extent with the efforts of the breeder but cases of atavism are, as a rule, extremely rare.

Among the various myths which have grown up around the subject of breeding we may mention those concerning maternal influence and the influence of a previous sire. Many writers have argued and thousands of instances have been collected to prove that experiences of the mother animal during pregnancy may produce definite effects upon the offspring. This matter has been investigated quite extensively and innumerable instances of this sort have been compiled. It is sufficient to say regarding this matter that no unquestionable evidence of any such case has ever been shown. Similarly with the belief in the influence of a previous sire, we find a great deal of talk mixed up with supposed observations of fact. It has been quite generally believed by breeders of pigs, cattle, horses, chickens and other animals that if a pure bred female bear offspring to a mongrel male or male of another breed, the influence of this male will always be manifest in subsequent offspring from other males or that such animals after once being "contaminated" can never again bear pure offspring. Recently

this matter has been tested very thoroughly by Prof. Ewart in breeding hybrids between zebras and the horse. His long-continued and careful experiments have shown as conclusively as may be that the theory of the influence of a previous sire must be entirely discarded.

In the various systems of breeding different methods have been used. In the origination of pure breeds it has often been found necessary to use in-and-in breeding. This term signifies the use of animals of close relation as for example where brother and sister and father and offspring are crossed. The purpose of in-and-in breeding is to get a considerable number of animals containing unmixed the blood of some animal which shows excellent characteristics desired by the breeder. Obviously if outside blood were mingled with this blood other tendencies would be introduced and the desired characteristics would perhaps be lost.

Cross breeding consists simply in crossing one pure breed with another so that the offspring are half breeds. This method has been resorted to at frequent intervals, particularly in the breeding of sheep. Similarly Thoroughbreds have been crossed with various other breeds of horses as indicated in the above discussion. As a rule however, this method is not to to be recommended for the reason that when various tendencies are mixed the results cannot be predicted with certainty and sometimes the undesirable points of both parents are perpetuated in the offspring.

The system of breeding described by some authors as line breeding may be defined as a mere extension of in-and-in breeding after the latter system has been in operation for several generations. In other words breeding takes place

exclusively between members of a family in one general line of descent without strict regard to the nearness of relationship. In most cases, however, it is obvious that the relationship would not be particularly close.

The only system of breeding which can be conscientiously recommended for the average farmer is that known as grading up. This consists in the use of a thoroughbred sire upon native scrub animals. The result is a great improvement of the native stock toward the standard of the thoroughbred sire used in any particular case. This system of breeding is the least expensive of any of those just mentioned and does not require the skill which is necessary in carrying out other systems with success.

As a matter of fact it is useless for the average farmer to go to any great expense in securing high priced, pure bred sires of any kind of animal provided he does not intend to use improved methods of caring for his breeding animals. Under scrub conditions scrub animals will give as much profit as thoroughbred animals and, of course, cost less.

To incur a great initial expense in securing thoroughbred sires makes it necessary to take better care of these sires, to use them so that the greatest possible number of offspring are obtained from them and to give extra care to these offspring in order to get out all there is in them. If the farmer is not prepared by training or experience or is not conveniently situated for carrying on animal industry according to the most profitable systems, with the best of care and scientific use of feeding stuffs and other methods strictly up to date, it will be impracticable to indulge in any fine

stock of any sort. This, however, should not be taken as an attempt to discourage the improvement of farm stock in all possible ways. It is simply a statement of the financial side of practical stock raising.

FEEDING HORSES

Horses are fed for quite different purposes than those for which other farm animals are fed. In the United States, horses are raised only exceptionally for the production of meat. The main purpose sought in the horse is work. They must be fed, however, with materials which produce an increase of weight, especially during growth and during the periods of fattening for market as well as for the production of energy. Energy may be compared with milk, wool, eggs, and other products produced by other animals aside from the mere increase in weight. In order to feed horses or any other farm animals successfully and economically it is necessary to give some heed to preparing and compounding rations. Food stuffs, as is generally known, contain a number of nutritive elements which are referred to in all literature relating to the feeding of animals. We may therefore briefly define the most necessary terms used in feeding. Protein is the general term used to include all sorts of substances in food stuffs which contain oxygen, hydrogen, carbon, and nitrogen in addition to phosphorus, sulphur and other constituents. Substances containing protein are also said to be albuminous or nitrogenous on account of the fact that they contain nitrogen. The white of the egg, the gluten of flour, and the casein of milk are familiar examples of protein.

Carbo-hydrates is the term used to denote nutritive compounds containing carbon, oxygen, and hydrogen in certain proportions. The most familiar examples of the carbo-hydrates are the starches and sugars and these are the carbo-hydrate elements which are of the greatest value in feeding stuffs.

Ether-extract as used in literature on the feeding of animals includes various oils and fats in feeding stuffs which can be extracted by means of ether. The amount of fat in various plants varies greatly. In general there is a larger amount of oil and fat in grains and seeds than in coarse fodders and still less in roots and fruits. Seeds of cotton, rape, mustard and flax contain large quantities of fat and similarly with beans and other leguminous seeds. Among grains, corn and oats contain large amounts of fat.

Crude fiber is the tough, fibrous part of plants and consists largely of cellulose and woody tissue. Obviously the amount of crude fiber in a plant depends to a large extent on the stage of growth at which it is harvested. In general, coarse fodders contain more crude fiber than grains.

All animals require a considerable variety of feeds in order to thrive best and most economically. Rations compounded on a proper basis according to the nutritive value are said to be balanced. The balancing of a ration implies that a proper amount of protein is obtained along with the fats and carbo-hydrates. All writers on the feeding of animals, use the term nutritive ratio in this connection to indicate the ratio between the digestible protein and the other digestible matter in any particular feeding stuff. In calculating the nutritive ratio, it has been found that fats

have 2.4 times the heat value of carbo-hydrates. The percentage of fat as shown in an analysis of a given food stuff is therefore multiplied by 2.4, the resulting quantity being added to the carbo-hydrates and the total of both being divided by the amount of digestible protein. In general nitrogenous grains may be taken as examples of a narrow ration, for example, linseed meal in which the nutritive ratio is 1:1.7, while in corn the ratio is 1:9.8, this being known as a medium ration, and in timothy hay 1:15.5, this being called a wide ration.

GRAINS FOR HORSES

In the following paragraphs attention is given first to a brief discussion of the various feeding stuffs which are commonly used for feeding horses, and later to a general discussion of suitable rations for horses. Feeding stuffs are grouped for the sake of convenience into grains, coarse fodders, roots and fruits, and miscellaneous feeding stuffs.

Oats.—Oats are quite generally considered as the best grain for horses. The belief is firmly rooted with a large percentage of horsemen that no other grain is suitable for horses or, at least, not for horses used for driving or speed purposes. Oats are quite nitrogenous and, therefore, furnish the protein which is necessary for the growing horse. They are also palatable and well liked by all horses. Another point in connection with oats is that the amount of hulls in the grain is considerable so that the masticated mass does not become sticky or solid in the stomach and, therefore, does not give rise to digestive troubles. Oats are cultivated as horse feed and for the production of

food for human beings in nearly all parts of the world. They are, therefore, available for horses wherever horsemen feel under the necessity of using them. In many localities, however, they are quite expensive when compared with other grains which may be obtained more cheaply. As a rule, oats are the grain for horses in the north-eastern quarter of the United States. Many years ago a chemist reported the discovery of a peculiar substance in oats under the name of avenine. This substance was supposed to contain a life-giving principle, characteristic of oats. The discovery was supposed to be substantiated by other investigations, but recent chemical work has failed to show the presence of any such principle in oats. One of the great advantages of oats, as compared with other grains, is that they may be fed in large quantities without causing indigestion or other serious troubles in the horse. Again oats may be fed, without any previous treatment such as steaming or grinding, to all horses so long as the teeth are in a suitable condition. They may be fed in rations of from 8 to 20 pounds per day according to the size of the animal and amount of work to be performed. Wherever oats are too expensive they should be replaced by some other grain as indicated in the following paragraphs:

When oats were compared with mixed grain composed of gluten meal, middlings, and linseed meal in Maine the best results were obtained and at the least cost from the mixed grains. In another test, oats produced less growth in colts than an equal weight of a mixture of peas and middlings, the ratio being 100:111. Peas are somewhat costly, however. In the test with the mixture of middlings, gluten meal, and linseed

meal in the ratio of 60:35:15 respectively the total cost of the ration was 12 cents while when oats were substituted for the grain mixture the ration cost 14 cents per day. The total gain in weight was one and three-tenths pounds on the mixed grains and two-thirds of a pound on oats. In Utah it has recently been found that bran and shorts mixed may be substituted for oats when horses are fed either timothy or alfalfa as roughage. As a rule, the cost of maintaining horses may be reduced by using bran and shorts in the place of oats. In North Carolina when oats were compared with cowpeas pound for pound, the ration being 4 pounds per day in addition to wheat, corn and cob meal, and meadow hay, the total cost was 24.4 cents in the oat ration and 20.4 cents for the cowpea ration. Both rations proved highly effective and satisfactory, but the cowpeas were evidently the most economical and practical feed for horses in North Carolina. In Maryland a direct test was made of the value of ground oats. In this experiment it was found that while horses readily digested oats either in the whole or ground condition, the grinding increased their digestibility to an appreciable extent.

Barley.—This grain is extensively used to replace oats. Its feeding value is about equal to oats and it is used for horses in California, and almost exclusively as the grain ration of horses in Africa and Asia. In Algeria horses receive scarcely any other grain and since horses in Algeria and Arabia are noted for their speed and endurance it is obvious that barley has great feeding value for horses. Barley is exceedingly hard and should preferably be cracked or crushed. It is still better to mix it with bran or a little molasses.

According to some experiments 4 pounds of barley are equal to 6 pounds of oats. Boiled barley is perhaps the best grain for colts. It gives a rapid growth and great strength of bone and muscle as well as sleek coat. In Germany a direct comparison of barley and oats showed that these grains were about equal in value as horse feed. As a result of these tests a ration was recommended for farm horses containing one-third oats, one-third barley, and one-third beans. In a comparison of barley and oats in North Dakota with heavy work horses barley did not prove quite as valuable pound for pound as oats, especially when the horses were taxed to the limit of their endurance. Some horses do not take so kindly to barley as to oats and the same fact is observed occasionally with mules. Malted barley proved not to be equal to whole barley in a continuation of this test. In fact, it did not prove to be an economical feed for horses. A number of horses were also fed on a mixture of malt and bran. This mixture, however, as compared with oats did not keep the horses in as good flesh nor did it produce an equal amount of work.

Corn.—This is the king of all grains for fattening purposes and for the production of energy. On account of its low protein content, however, corn should not be used extensively in feeding growing colts. Good corn, however, may be substituted for oats without injury to the health of animals. Old horses may not be able to eat it without previous grinding. A mixture containing 50 per cent. corn, 15 to 20 per cent. cracked beans, 10 to 15 per cent. bran, and 10 to 20 per cent. of malt makes an excellent ration for a horse when 10 to 15 pounds of the mixture are used daily. An-

other very effective mixture for feeding horses and which is considered as equal to 220 pounds of oats consists of 154 pounds of corn, 10 pounds of ground meat, and 11 pounds of chopped straw.

As is generally known street car and bus companies in Europe as well as in the United States have extensively tested the feeding of corn to horses for the purpose of determining not only its suitability for substitution in the place of oats but also its possible effect on the health of horses. In England ten street car companies determined upon a ration of four pounds of corn, six pounds oats, two pounds beans and peas, and one-third pound of bran. In Leipsic a ration of ten pounds of corn and three pounds of oats was fed to bus horses at hard work. Horses, after a continued use of this ration, were in better condition than when on an exclusive oat diet and the coat was smoother and sleeker. It was concluded from these experiments that oats had been somewhat overestimated by horsemen and that an exclusive oat ration was not only not necessary but not even as desirable as mixed grain. It has been found that corn is well adapted to the production of energy in work horses. Five lbs. of corn may be substituted for six lbs. of oats for farm horses. When the ration consists of part oats and part corn it is well to feed the oats during the day and the corn in the evening since the corn is less readily digested than the oats. Before feeding corn may be soaked for twenty-four hours or may be fed in the form of corn meal, corn and cob meal, shelled corn without grinding or cracking, or even in the ear. In Utah the use of a ration of corn meal and timothy hay did not sustain work horses as well as oats and clover. This, however, was to be expected since the protein con-

tent of the second ration is much higher than that of the first.

In general it may be said that extensive experiments on a commercial scale have shown that the feeding value of corn is equal or in some cases superior to that of oats. Corn is the chief grain fed to horses and mules throughout the southern states and in fact until recently it has been almost the only grain used for this purpose in the South. In North Dakota feeding experiments showed that seventy-seven and one-half pounds of corn were equal to 100 pounds of oats for work horses. According to some authorities corn incites perspiration and renders horses softer than when oats or barley are fed. Lavalard, who has made a most extensive study of corn as a feed for horses, reports that for cavalry and artillery horses as well as for all horses at hard work, corn may be used to replace oats without in any way injuring the horses. Horses which received corn were able to work more hours and to travel at the same gait as those which received oats. The constituents of oats are perhaps more easily and somewhat better digested than those of corn but corn in turn is more easily digested than beans which are often used as a horse feed. In North Carolina some advantage was found in grinding corn for horses and excellent results were obtained when horses were fed corn and cob meal. Again whether grinding is to be recommended depends entirely on the cost of grinding and the distance of the farm from a suitable mill. Similar results were obtained in Maryland where corn meal was found to be considerably more digestible for horses than shelled corn.

Cotton Seed Meal.—This meal, as is well known,

is highly nitrogenous and has been found to be a very effective feed for the production of beef, milk, and pork. When fed in too large quantities without suitable roughage it has been found to be more or less injurious or poisonous. For that reason it is recommended by some authorities that cotton seed meal be not used as a feed for horses, especially for brood mares. In New Hampshire it was found that at first horses did not like cotton seed meal and refused to eat it. Gradually, however, they acquired a taste for it and it proved to be one of the cheapest grain rations when compared with other rations containing other grains. In North Carolina it was found that from two to four pounds of cotton seed meal could safely be fed to horses at work. In some cases horses gained considerably when at hard work on the ration containing cotton seed meal. This substance may be used to replace a corresponding amount of other grains in the ration with an advantage in the amount of work performed by the horses and with economy in the feed.

Rye.—This grain, though not raised in large quantities, may be safely fed to horses if convenient and if the grain is in a clean condition. The oil contained in rye is perhaps less easily digested than that of oats and in general rye cannot be considered as equal to oats as a grain ration for horses. Nevertheless rye may be used to replace some of the oats in the ration. It is usually recommended that rye be scalded before using and that horses be gradually accustomed to it. As is generally known rye is sometimes attacked by ergot. If infested with this disease it should be fed very sparingly since horses may ultimately become affected by eating ergot. In some of Lavalard's ex-

periments rye was substituted pound for pound for oats but in general it should not be used to replace more than one-third of the oats in the ordinary ration. Rye may be fed whole, cracked, boiled, as flour, or baked as bread. While cockle seed is sometimes considered harmful and is found in rye screenings it has been found by certain tests in Germany that rye screenings containing a considerable quantity of cockle seed in rations of two pounds per day did not cause harm.

Wheat.—Wheat cannot be profitably fed to horses when in prime condition, as it is of too much value for use in the manufacture of flour. Whenever the market price is low, however, or when the wheat has been injured by frost or in elevator fires, it may be fed with good results. Wheat is quite readily digested, but should usually be mixed with some other grain in order to obtain the best results. In North Dakota a comparison of ground wheat, and bran with oats showed that the wheat and bran ration was considerably superior to oats. When horses were fed a fine quality of wheat for three or four weeks in succession in rations of 14 pounds daily, it was found that horses working for nine hours a day maintained their health and increased in weight. In some cases, however, the digestion ultimately became somewhat deranged and a considerable portion of the wheat kernels passed through the alimentary canal undigested. Apparently it is not advisable for the average farmer to use wheat as an exclusive grain ration for horses. In feeding stallions, a certain amount of wheat is often substituted for part of the oats in the grain ration. It is necessary, however, in such rations to use the utmost precaution since wheat may produce an irritation

or itch after long periods of feeding similar to the results produced by buckwheat.

Buckwheat.—In this country buckwheat is cultivated on an extensive scale only in a few regions, particularly in New York. It, therefore, is not used as a general horse feed. In various parts of Europe buckwheat has been used to a limited extent to replace oats as a part of the grain ration. The maximum daily ration may be placed at about four to six pounds. Buckwheat is not as readily digested as oats and has the further disadvantage that it may become pasty and somewhat unpalatable during mastication. It may be fed, however, both whole and ground, particularly in the form of middlings and bran since the flour is ordinarily used as human food.

Rice.—On account of the recent extensive cultivation of rice in the southern states, particularly Louisiana and Texas, this cereal and some of the cheaper milling products from it have been tested quite extensively as stock food. In a number of tests it has proved a valuable feed for both horses and mules. It may be fed whole or preferably in the form of rice bran, rice polish or some other milling product. The composition of rice is such that it may be used as a substitute for other nitrogenous grains without changing the amount, but not all horses take to rice at once without previous experience.

Kafir Corn.—This grain, as is well known, is grown extensively, particularly in the dry regions along the northwestern border of the cotton belt. In Kansas and Oklahoma it has been fed to horses and mules with good results. Kafir corn is a carbonaceous grain and has a very similar composition to corn. It may, therefore, be used

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almost pound for pound as a substitute for corn in horse rations. In some cases it is not eaten so readily as corn, but no especial precautions are necessary in feeding it since it appears to be safe and wholesome.

Millet.—Millet, especially when ground in the form of a meal, is quite suitable as a part of the grain rations for young, or developing horses. It is somewhat more nitrogenous than oats but has a smaller fat content. Some feeders have found that millet is very desirable in producing energy in work horses. In North Dakota, when cut just before maturity and fed as the only coarse forage to horses, millet after a considerable time exercised a very injurious effect on the liver and kidneys, causing increased action of the kidneys followed by lameness, swelling and distortion of the joints, softening of the bone tissue and death in a number of cases. The causes of this effect of millet are not well understood, particularly since it has been extensively fed in many localities without any such effects.

Beans.—Beans of all kinds have been fed to horses with excellent results in the production of energy. Recently, Java beans, particularly the wild ones, have been found to contain prussic acid at times, but this is apparently not true of the cultivated varieties. The nutritive value of beans is very high and for this reason they should not be used to replace any large proportion of the usual grain ration of working horses. The common variety used for feeding purposes is horse beans. Paris cab companies have used this bean extensively and recommend that when fed to replace a part of the oats in the ration one pound of beans be substituted for two pounds of oats.

Nearly all horsemen say that beans are especially suited as a food before long-continued, sudden, or severe exertions, and this seems to be well founded. In some of the leading racing stables of England a considerable proportion of beans is used in the ration of young horses during training. In experiments with work horses, it has been found that not more than four pounds of the usual amount of oats or equivalent grain in the ration should be replaced with beans. It must be remembered also that on account of the high protein content of beans an additional amount of starchy food may be given to balance the ration.

Peas.—Peas contain twice as much nitrogenous material as oats and are, therefore, indicated as a valuable grain food where energy or the production of tissue is required. Peas are practically equal to beans in feeding value, but since they have a slightly constipating effect it is recommended by Stewart that a mixture containing eight parts peas, eight parts corn, and one part flax seed be ground together and suitable rations given from this mixture. The continued feeding of peas in large rations is occasionally said to produce a bad effect on the kidneys, causing bloody urine. This complaint, however, has not thus far been substantiated. Peas as well as beans may be fed cracked, ground, or cooked. On account of their hardness it is undesirable to feed them whole.

Various other leguminous seeds such as vetches, lupines, lentils, flat pea, carob bean, etc., have been fed to horses to some extent, but their use will naturally be confined to localities in which these materials can be obtained conveniently and at a reasonable price.

Bran.—Bran is known to all horsemen as a valuable feed. It is considered as having a slight laxative effect and as maintaining a good condition of the skin and a softness and silkiness of the hair. Even when it is not used as a continued part of the ration it is usually fed once a week or oftener in the form of a wet mash. Recently the Canadian government made a direct comparison of the feeding value of bran and oats for heavy horses. It was found that the oat ration in order to be as effective as bran and oats cost two cents per day more for each horse. A ration containing two parts of bran, one part of linseed meal, and two parts of oats is considered as an almost ideal grain ration for horses. In some cases the use of a large quantity of bran, apparently makes animals soft and inclined to perspire more readily than when oats or other grains are used. A comparison of bran with oats in New Hampshire showed conclusively that bran may be substituted for oats with a saving in the expense of the ration. A mixture of corn and bran was found to be an exceedingly effective and cheap ration for both summer and winter work. In North Dakota a combination of bran and shorts proved to be equally as effective as oats for horses. The results of this experiment show that when oats are worth 25 cents a bushel bran and shorts are worth $15.60 per ton for the same purpose.

Horse Bread.—The use of bread for feeding horses is familiar to nearly all horse-raisers. Bread for this purpose has been made from the flour of wheat, rye, barley, and other cereals, and in some cases has been mixed with various other materials including blood, milk, molasses, etc. In one instance a horse bread prepared from skim milk and

oats was directly compared with oats alone as a horse food. The horse bread had to be used in rations of twice the weight of the oats in order to give the same results. The bread, however, was relished by all horses and did not appear to cause constipation or other bad effects. On the contrary it appeared to be palatable and readily digested, partly on account of its mechanical condition. The use of bread made from any kind of flour for feeding horses will naturally depend entirely upon the price of flour which is usually too high as compared with untreated grains. The use of bread for horse feeding will not be extensive for some time to come.

Dried Brewer's Grains.—Farmers have learned the high feeding value of dried brewer's grains for various kinds of stock and at present all of this material is ordered far ahead of the actual production so that it is somewhat difficult to obtain it. The most extensive experiments in feeding dried brewer's grains to horses have been carried on in New Jersey, where it was found that this material was quite as useful as oats, pound for pound in a ration for horses. When dried brewer's grains were substituted for a part of the oats in the ration containing hay, wheat bran, and corn, a saving of five cents per day per horse was accomplished. In feeding this material to horses it should be remembered that one pound of dried brewer's grains is equal to four pounds of wet, and is far more desirable than the wet grain.

Dried Distillery Grains.—This material, until recently, has not been fed to farm animals so extensively as dried brewer's grains and has not been subjected to as careful feeding tests as the latter. Since, however, it appears to be impossible,

or, at least, not economic to feed horses on exclusive grain rations of oats, it has become necessary to study carefully all possible substitutes for oats and where barley, corn, Kafir corn, wheat, or beans are not available at reasonable prices, it may be desirable to use various milling products, such as dried distillery grains. This product was recently tested in Indiana. The material used was what is known as Viles Fourex distillery dried grains with a guarantee of 33 per cent. protein. Different horses ate different quantities of the grain, varying from six to 50 pounds per week. As a rule neither horses or cattle took kindly to it and some animals never ate a ration of suitable size. It appears, therefore, that dried distillery grains are lacking somewhat in palatability as a horse feed and, therefore, it is not necessary to discuss the economy of feeding this product.

Linseed Meal.—Linseed meal, as well as ground flax seed, has a laxative effect and is fed occasionally on account of this medicinal property, as well as on account of the fact that it has a tendency to keep the coat in a glossy, sleek condition. In New Hampshire it has been shown that as much as four pounds of linseed meal per day may be fed without producing any bad effects on the horse. In general, however, large quantities are not eaten with much relish and on account of the high price of this product and its medicinal effect it is quite unnecessary to feed it in such large quantities particularly for long periods. About two pounds of linseed meal and two pounds of bran, in addition to eight pounds of corn, constitute an excellent grain ration for work horses. It has sometimes been asserted that when horses have been fed for a considerable period on linseed meal it is unsafe to

make a sudden change to a ration without the linseed meal. Direct tests seem to indicate that there is no danger in suddenly adding two pounds of linseed meal to the ration or in suddenly leaving it out after a continued use of this product.

Whole vs. Ground Grain.—The cost of grinding grain for feeding to animals has been considered by a great many stockmen to be an unnecessary expense in animal industry. In general, it has been found that the expense of the process must be taken into consideration. Where the farmer is conveniently situated near the mill, and where the expense of grinding the grain is not great, as for example by the use of a power feed grinder on the farm, the advantage obtained in the increased digestibility of the grain may more than equal the cost of the grinding. For horses with good teeth it is not necessary to grind oats, soft wheat, buckwheat, or Kafir corn, but beans, peas, and barley are improved by cracking or grinding. If the teeth are poor, as in old age, or when they are being replaced in colts, it is desirable to grind or otherwise soften the grain used in the rations. The problems connected with this question have been carefully considered in various localities. In Utah it was found that whole oats, wheat, or corn were equally as effective as after grinding. It was estimated, in making these tests, that in order to pay for the process of grinding, ground corn must show an increased effectiveness of fifteen to twenty per cent. and as no increased nutritive value was obtained from the ground corn, the grinding was, therefore, done at a loss. All horsemen know that it is an important matter to keep colts growing uniformly after they are weaned. In accomplishing this result, since, as has already been indicated, the teeth

are being shed and replaced at intervals until the horse is five years old, it is necessary to take account of the condition of the grain during this period. In Iowa a test was made of the value of grinding different grains for colts, with the results that somewhat greater growth was obtained when oats, corn, barley and wheat were ground. It is a curious fact that in localities where grain is cheap the farmers as a rule do not expend any energy in grinding grain for horses, while in New England and the more thickly settled parts of the country with high prices for grain, additional expense is usually incurred in grinding or otherwise preparing the grain for the horse. It is the belief held by most horsemen that the increased digestibility and food value of the grain after grinding somewhat more than pays the expense of grinding. A further test of the matter in Utah, however, showed no advantage in grinding grain for horses. Naturally the question must be left with each individual to be judged according to the hardness of the grain and to the condition of his horses, particularly with reference to their teeth.

Cooked vs. Raw Grains.—Certain grain mixtures are rendered much more readily available for horses by cooking or steaming. The relative digestibility of cooked and uncooked grains, however, has not been determined with any great accuracy. In some cases cooked grains appear to be less digestible than the same grains fed in the natural condition. As a rule it does not pay to cook any kind of food for farm animals, but certain well-known exceptions occur and these will be mentioned in other places. For horses, for example, it is desirable to cook potatoes, since otherwise they may cause colic or other digestive troubles if fed in

large quantities, but grains need not be cooked or steamed before feeding to horses, excepting cases in which a very rapid growth is desired or in fattening horses for market. In the case of brood mares, stallions, and horses being fattened for market it may be desirable to use boiled food at intervals or, in the case of draft horses being prepared for market, once or twice daily. The cooking of grain in cold weather has not been found to give any advantage, excepting cases where the horses' teeth are in bad condition.

HAY AND COARSE FORAGE

The hay used for horses varies greatly in different parts of the country. In general timothy has long been considered by horsemen, especially for racers and speed horses, as the only desirable coarse forage. In all localities where timothy is fed as roughage to horses, clover is likewise a common hay and is often fed mixed with timothy as they grow in the meadow, or often constitutes the more important part of the roughage. Throughout the Rocky Mountain region of the country alfalfa is considered as the best roughage for horses. In California barley, oat, and wheat hay, particularly barley hay, is fed extensively, the hay being cut when the grain is in the milk. Throughout the corn belt and in the South, corn fodder constitutes one of the most important parts of the roughage for horses. It is thus apparent that just as there is no one exclusive grain ration for horses, so there is no one exclusive coarse forage which is universally better than any other for horses.

Alfalfa.—Alfalfa, as already indicated, is one of the best, if not the best, hay particularly for work-

ing horses. This hay has been studied carefully in the United States and in European countries with reference to its availability for horses and other farm animals and as to the possible medicinal effects from its use as a food. In Germany alfalfa hay has been found superior to ordinary meadow hay, furnishing about 180 lbs. more of nitrogenous matter per acre. Alfalfa has been fed to brood mares with excellent results and without producing bad effects on the mare or foal. In Oklahoma and other states and territories where it has long been fed to horses under careful observation it is pronounced the best possible coarse food. It has sometimes been accused of causing heaves and bloody urine, but this does not appear to be the case under normal conditions. As before stated it is the almost exclusive feed of young horses in all of the Rocky Mountain states and if it had the tendency to produce heaves or bloody urine or other undesirable effects these would have been noticed much more frequently than has been the case. On many farms, horses are maintained at hard work on alfalfa alone without any grain. On account of this observed fact a study was made of alfalfa as an exclusive maintenance ration for horses in Utah. It was found much easier to maintain the weight of horses on alfalfa than on timothy, the cost of the maintenance was always less, and the appearance of the horses was in every case in favor of the alfalfa ration. No bad results were noted on the health of the horse and it was found that colic and other digestive disturbances could be prevented by rational treatment of the feed. In general it may be stated that too much hay is fed to work horses on the farm. In some localities the amount of hay fed to such horses might profitably be reduced

one-half and the grain ration increased to a slight extent to make up for the hay. It has been found that the horse which is used to alfalfa hay will eat from 35 to 40 lbs. per day when it is fed ad libitum. This large quantity of hay, however, is likely to cause colic and other disturbances. If the amount be reduced from 10 to 12 lbs. the digestive disturbances will not be noticed except in rare instances. Some writers have stated that alfalfa has a diuretic effect on the kidneys. A careful study of this, however, comparing the effect of early, medium and late cut alfalfa fails to show that any bad effects can be attributed to alfalfa. It is very doubtful whether there is any economy in allowing horses to eat 40 pounds of alfalfa per day. Twenty lbs. is sufficient for the maintenance ration and the same quantity with a considerable grain ration is enough for the horse at work. In Wyoming it has been found that alfalfa hay, with straw given ad libitum, makes a good maintenance ration for horses and is sufficient for light work without any grain. Horses were readily maintained on 14 lbs. of alfalfa per day with liberty to eat straw at a stack but without grain. In other tests 15½ lbs. of alfalfa, 2½ lbs. of oat straw, were required for a maintenance ration. It is generally considered that 12½ lbs. of alfalfa and 2 lbs. of oat straw are a maintenance ration for horses per 1000 lbs. of live weight.

It is scarcely necessary to give a detailed record regarding all the experiments on the feeding of different kinds of coarse fodders to horses. Timothy, clover, alfalfa, corn stalks, and cereal hays are the standard materials for this purpose in different parts of the country. Nearly all kinds of coarse fodders, however, have been fed to horses in different states. Horses do well on beggar-weed hay where

this material can be obtained in suitable quantities. Similarly with brome grass. No unfavorable results are recorded after its use as a substitute for timothy. In some cases its feeding value seems to be slightly higher than that of timothy. Clover hay is everywhere used as a feed for horses, substituted for timothy or in mixtures with this grass. As is well known, moldy clover may affect the kidneys and liver to some extent or in certain cases may even cause serious disease and death. It is also noticed that clover, especially second crop, may induce slobbering in horses. The exact cause of this is not known but usually the addition of bran or apples to the ration partly stops the tendency to slobber. Clover hay may be cut into short lengths before feeding and when this is done it is not so likely to cause sore mouth by pricking the mucous membrane as is the case with timothy and other stiff stemmed grasses. Clover hay should in all cases be clean and not moldy, since any but bright clean clover may lead in the end to digestive troubles and may also cause heaves. It should not be imagined, however, that ordinarily clover hay is undesirable as a horse feed. Comparative tests have shown its feeding value to be considerably greater than timothy and when fed by experienced men danger from its use is exceedingly slight.

Corn stover is fed to horses as a coarse forage throughout the corn belt. It may constitute the only coarse fodder in the ration or may be used to replace a part of the hay. Where corn stover and timothy hay or other common meadow hays have been compared the stover has proved of about equal feeding value. No undesirable effects from the use of clean corn stover have been noticed. The new corn product, which is corn fodder with the

pith removed and ground into a coarse meal, may be mixed directly with the grain ration so that all the different elements necessary in the horse ration are fed at the same time. In tests of this material it has proved a very desirable form in which to feed corn fodder.

Cowpea hay contains so much protein that it may be used to some extent to replace grain. In fact, as the result of some tests of cowpea hay it appears that this forage is equal to bran in feeding value. As a rule, however, no coarse forage, however nitrogenous, can completely replace all of the grain in the ration, especially in the case of horses which are accustomed to receive a ration containing a considerable amount of whole or ground grain.

It is generally desirable that hay should be fed for the most part at night, small rations in the morning and none at noon. This arrangement is to be recommended on account of the fact that when hay is eaten in considerable quantities at the same time with grain it may carry some of the grain through the stomach before it is completely digested. Horses soon become accustomed to eating their grain ration without hay at noon and in the morning they need but little hay if they have been fed a suitable ration the night before. As already indicated hay may be cut into short lengths and mixed with the grain. There is no objection to this practice and in the case of clover hay its digestibility seems to be somewhat increased. With some horses, however, the sharp ends of the cut pieces appear to make the mouth sore. Millet hay as well as the grain is usually recommended as a valuable feed and excepting for one experience in North Dakota no complaint has been made

regarding its injurious effect. In that state however, continued use of millet was found to irritate the kidneys in a pronounced manner, to cause various symptoms of brain trouble accompanied with struggles and also to affect all of the bones and joints. All of the cereal straws are used for feeding horses as a partial substitute for hay or other material in the coarse fodder. Oat straw is perhaps the most desirable for feeding horses, followed by barley, wheat and rye straw in the order of their nutritive value. When horses are fed straw they require some extra grain but in some cases the saving in hay more than compensates for the additional grain required.

Pea hay may be fed to work horses for months at a time without harm and in some of the southern states has been found to increase the beauty of the coat of horses and mules in a way which can be accomplished by no other food. It may be fed in rations of 10 lbs. per day, mixed with corn stover, sorghum and other coarse forage. Occasional complaints have been made that this hay causes bloody urine and other kidney troubles, but this seems not to be the case when it is fed in a rational manner. Horses have been kept at hard work for several months on pea hay without any grain.

Pasture for horses naturally varies in different parts of the country and need not be discussed at any length for the reason that the feeding value of the different forage plants found in pastures has already been discussed. Ordinary pasture without grain is not enough for horses used to a heavy grain ration. When such horses are turned out upon pasture it is usually observed that they fall off in weight. This is due partly to their inability to get sufficient nourishment at first from the

pasture, and also by worry caused by flies, absence of shelter and lack of grooming. It thus comes about that overworked horses accustomed to large feeds of grain, when turned upon pasture without grain for a rest period, are often in poorer condition at the end of this period than when placed upon the pasture. Some grain is desirable in nearly all such cases.

Silage has been quite extensively fed to horses without bad results provided the material is in a wholesome condition. Musty silage may cause serious poisoning or death. In some localities difficulty has been experienced in feeding horses silage in winter on account of the ease with which it freezes. It has been fed in varying quantities, some feeders obtaining good results from the use of 30 lbs. per day. In the majority of cases, however, 10 to 12 lbs. will be found sufficient, and even then it must be in good condition, not musty nor improperly fermented. Good silage appears to be a perfectly safe and suitable forage for horses when fed together with some leguminous, cereal, or meadow hay. Silage when fed in this way replaces a portion of the grain ration and also a part of the roots which are usually fed to horses.

Sorghum hay is about equal to corn fodder in feeding value in a dry state, but somewhat superior in a green condition. It loses rapidly under careless curing. Sorghum hay may be mixed with alfalfa for the purpose of balancing the ration. In general there appears to be little danger from sorghum if it is fed with other coarse fodders. Occasionally, however, as has recently been shown, especially in the case of cattle, this forage plant may at times contain prussic acid and is then a deadly poison.

Various other forage plants, as already indicated, have been and are fed to horses in various parts of the country. Thus sweet clover is a valuable horse feed in cases where it is eaten with relish. It should be cut at an early stage and cured like alfalfa. Horses must first become accustomed to it before they will eat it in large quantities.

ROOTS AND FRUITS

Roots should always constitute a portion of the horse ration. It must be considered that on account of the comparatively small size of the horse's stomach they cannot successfully be fed to horses in as large quantities as to cattle or sheep. As a rule about six to ten pounds is a suitable ration of roots per day. The feeding value of the different roots varies so slightly that they may be used interchangeably to replace one another. Their most important point is to add palatability and variety to the ration as well as some succulence. This is accomplished by feeding carrots, beets, or pumpkins. Turnips may also be fed for the same purpose. The use of fruits as a horse feed is not a very important practice excepting in certain localities. All kinds of fruits are known to possess some value on account of their palatability and their chemical composition. In the far west almond hulls, apples, apricots, grapes, peaches, figs, and raisins either fresh or dried have been fed to horses. Naturally when fruits are dried their feeding value is considerably greater than in the fresh state.

Carrots are one of the common root crops for horses and almost everywhere constitute a portion of the ration. They may be fed in rations of

four to five pounds to colts and eight to ten pounds to adult horses. They need not be run through a grater. Carrots are beneficial on account of the succulence added to the ration and are also slightly laxative. Mangels may also be fed in the same manner as carrots, in rations of six to ten pounds per day, with or without cutting. In parts of the South where cassava is grown, this material is used as feed for horses, but it is not very well relished and appears not to be particularly desirable as a horse feed.

Potatoes have been extensively fed to horses both in a raw and cooked condition. A ration of twelve pounds of raw, wholesome, ripe, unsprouted potatoes may be fed to horses with good results. If large potatoes are used they should be sliced, while small ones may be fed whole. It is desirable to mix potatoes with straw or hay and horses should not be watered too soon after feeding, otherwise colic may develop. Potatoes on account of their high starch content may be substituted for a part of the corn in the grain ration. They apparently do not cause sweating as has sometimes been stated for in many instances horses have been found to show better appearance when potatoes have been added to the ration. Many feeders have strongly recommended that potatoes should always be steamed or boiled before feeding, claiming that raw potatoes have a tendency to cause colic. Potatoes may be successfully compounded in rations with peas, beans, lupines, and other leguminous seeds.

Horses soon acquire a liking for pumpkins and may receive some benefit from eating them. In certain instances pumpkins have apparently had a slight curative effect in cases of asthma and

heaves. They may be fed in rations of ten to twelve pounds a day or much larger rations, if desired, without danger. Sugar beets have been extensively fed to horses and other animals. They may occasionally cause horses to scour and some feeders recommend that a single feed a week is sufficient. If horses are receiving alfalfa or some other laxative feed they do not need sugar beets in the rations. Sugar beet pulp apparently assists in digesting hay and grain in horse rations, and may be safely fed to the extent of twenty to forty pounds per day. The smaller ration, however, is usually most desirable. Sweet potatoes constitute a good root food for horses. They are relished and the addition of sweet potatoes to the ration as a substitute for a part of the corn ration can be made with benefit to the horse and with economy. The usual ration of sweet potatoes recommended by feeders who have tried them, is ten to fifteen pounds per day. Turnips may also be used as a part of the ration, being given to the extent of ten pounds per day. The experience of Canadian feeders appears to indicate that the use of some kind of root in the ration to the extent of five to eight pounds per day serves to prevent indigestion.

MISCELLANEOUS FEEDS

A number of feeds of a miscellaneous nature have been used in horse rations more or less successfully. Milk is a more important element in horse rations than is usually suspected. Many feeders have found it greatly to their advantage to feed colts cows' milk or separator milk. Colts give as good returns for the milk as any other animals and

develop strong vital organs and good bone when receiving milk in the ration. Young colts may be profitably fed from five to ten pounds of separator milk.

Molasses has long been fed to horses, cattle and other domestic animals and recently quite an unusual interest has developed in the use of this material. Apparently molasses hastens the passage of the food through the alimentary canal to some extent. The feeding value and the place in the horse ration is essentially the same in the case of molasses, sugar, syrup and various mixed feeds which contain molasses as a constituent. Sugar does not appear to affect the digestibility of the other parts of the ration. Molasses may be fed in small quantities to replace a portion of the grain or in larger quantities depending on the market value of the different feeds and the convenience with which molasses can be obtained. In some instances one or two pounds of molasses is fed per day, while in other cases the amount is much greater, even up to thirty pounds. It has been found that horses will keep in good condition with a large amount of work when receiving seven pounds of corn and nine pounds of a mixture of straw and molasses in equal parts dried at a temperature of 110° F. Molasses has the advantage of rendering inferior hay more palatable and thus increases the amount of available food material on the farm. In some instances it has been recommended as useful in colds and in all cases is effective in making horses fat at comparatively small expense. Throughout the southern states, molasses is widely used on the plantations for feeding horses and mules, the rations varying from two to twenty-eight pounds per day. Molasses

has been mixed with blood, ground corn, and various other materials in the production of combination molasses feeds. Thus blood-molasses has been manufactured from a combination of 250 parts blood, 200 parts molasses, 200 parts oat bran, 100 parts corn meal. Various forms of peat-molasses have also been fed to horses. Blomo food is a mixture of ground corn stalks or some similar material with dried blood and refuse molasses. It is a black sticky material recommended by the manufacturer as a substitute for oats. It may be fed to horses in daily rations of six quarts without harm but it is rather expensive and does not keep very well, especially in hot weather. Molasses unless very carefully mixed with hay, grain or some other material makes the manger exceedingly gummy and dirty. Under the best conditions it is a nasty feeding material and attracts flies in warm weather. Moreover recently some experiments have shown that the feeding of molasses or sugar in any form to horses may lead to diabetes and, if persisted in, to more serious kidney diseases in which albumen is found in the urine. It may be wise therefore to feed this material with caution until its exact place in the ration has been better established.

VARIOUS OTHER FEEDING MATTERS

Horses are usually fed for the production of energy. It should be remembered, however, that horse flesh is just as valuable an asset as additional weight in steers. The weight and appearance of horses count greatly in their market value. In order that the best price may be obtained it is necessary, as already indicated, to put the horse

in a fat condition. For this purpose the teeth must be in good shape and attention should be given to the digestive organs. In the case of most feeders who prepare horses for market the hay is fed in self-feeders and grain is given four or five times a day. According to one scheme which is in considerable favor the horses are fed corn in the ear at 5 a.m., receive water at 7 a.m., hay in the racks and three quarts of a mixture of one-third oats and two-thirds bran at 9 a.m., corn in the ear again at 12 m., oats, bran and hay at 3 p.m., water at 4 p.m., corn and hay at 6 p.m. The daily corn ration is about fifteen ears. The clover hay must be free from defects and some advantage is derived from steaming the grain. Linseed meal should be given occasionally, say once per week. In a feeding regime such as this, horses gain from three to five pounds per day and in rare instances even seven pounds daily. Bran is an excellent feed for both colts and mares of the draft type. In fattening draft horses for market, from ten to twelve pounds of a mixture of corn and peas, or bran, oats and corn may be given or a mixture of three parts oats, two parts bran, or a mixture of corn, peas, bran, wheat, and shorts. In such cases the daily ration may consist of eighteen ears of corn, given in two feeds, fifteen quarts of oats and bran mixed with about ten pounds of hay. According to the experience of a number of feeders, however, the fattening of horses for market may be best and most quickly accomplished by feeding them a mixture of boiled barley, ground corn, and molasses. Some feeders recommend a feed consisting of three pounds boiled barley, two pounds of corn meal and linseed meal at the rate of one pound per day.

NARROW VS. WIDE RATIONS

The narrow ration is always desirable for growing colts and for mares until the colt is weaned. Some difference of opinion prevails, however, regarding the comparative value of narrow and wide rations for the adult horse at work. In one set of experiments where corn and timothy as a ration were compared with a ration of oats, clover and timothy, it was found that the horses which received only the corn and timothy did as well as the others and that consequently for work animals a wide nutritive ration was equal to a narrow one and of course considerably cheaper. Other experiments continued along the same line, however, showed that corn meal and timothy did not sustain work horses as well as oats, wheat and clover and upon this experiment it was recommended that a narrow ration be fed, particularly in summer. In winter, however, a wider ration was suggested.

It has been found practically impossible to maintain horses on an exclusive grain ration. No farmer, however, would think of feeding in this manner and the fact has simply a scientific value. It appears that horses as well as other herbivorous animals need some coarse forage along with the grain in the ration.

Considerable attention has been given to determining a maintenance ration for horses. As a rule when horses are not at work they are fed the usual form of coarse forage, timothy, clover, alfalfa, corn stalks, cowpea hay, etc., and a small quantity of grain or none at all. In such cases hay is fed ad libitum and the amount eaten per day is therefore not determined. Alfalfa has been extensively tested for the purpose of determining

the amount necessary as a maintenance ration for horses. In some localities in the winter it has been found that for this purpose from fourteen to sixteen pounds per day is sufficient without grain. In some localities it has been found that after alfalfa has been fed to dairy cows the coarse stalks left by the cows are readily eaten by the horses. The amount of such material necessary for maintenance is higher than when first class alfalfa is fed. In Utah it was found possible to maintain horses in good condition upon thirty-two pounds of alfalfa daily. Better results were obtained, however, when the amount of alfalfa was not more than twenty pounds, and when some corn was substituted for the remainder of the alfalfa.

Horses like all other animals frequently get off their feed as the common saying is when fed carelessly or without regard to a suitable balancing of the ration or variety of feeds. In order to avoid the loss of appetite and the actual development of digestive troubles considerable attention should be given to the proper compounding of the ration. A slight loss of appetite may be due to a lack of variety and this occurs most often when the same grain ration is fed for a long period, particularly if the grain ration is composed exclusively of one variety of grain. Some improvement is always obtained in such cases from the feeding of mixed grains as well as a coarse fodder. Loss of appetite may, however, be due to overwork, lack of exercise, or to the defective condition of the forage as well as to lack of variety. In cases of loss of appetite horses may be fed a mixture of crushed oats, corn meal, and linseed meal with small quantities of silage added and in persistent cases with the addition also of a spoonful of sulphate of iron

or powdered gentian. It has been observed that a systematic course of feeding and water is a preventive of disease. The importance of systematic feeding may be noticed from the fact that irrational feeding may cause a variety of diseases including abortion, heaves, swelled legs, founder, scratches, sore mouth, urticaria, gastritis, constipation, dysentery, azoturia, diabetes, bloody urine and many other diseases. Abortion may be caused by the feeding of rotten food or of material infested with ergot. Founder and azoturia may be caused by excessive feeding at times when little exercise will be taken for the next 24 hours. Diabetes may be caused by excessive feeding of sugar or molasses and bloody urine sometimes results from the excessive use of nitrogenous feeds, especially cowpea, lupine forage, etc. While considerable variety of opinion prevails regarding the manner in which hay, water and grain should be given to horses in order to secure the best results from the feeding stuffs and to prevent digestive troubles, a simple rule to remember and one which will give favorable results is simply to give water at least half an hour before or after feeding.

The amount of water drunk by horses naturally varies according to the temperature, severity of work, and the ration fed. In one experiment when alfalfa and timothy were compared in this respect it was found that horses eating alfalfa drank 107½ pounds of water daily while horses on timothy drank 103¾ pounds. Horses at rest, however, drank considerably less, so that the average amount daily for horses on alfalfa was 88 pounds and for those on timothy 78 pounds. Therefore the character of the food excercises an appreciable influence on the amount of water required by horses. The

amount of water also varies considerably on account of the difference in individual horses without relation to other factors. In a direct test regarding the influence of the time of watering upon the weight of the horse it was found that horses watered before they were fed grain maintained their weight better than when watered after the grain ration. The appetite also appeared to be better when the water was given before the grain although the digestion was not influenced by the time of watering. In general it appears to be desirable to water horses both before and after feeding providing the interval is one half an hour or more.

THE COST OF HORSE RATIONS

The cost of keeping horses naturally varies according to the character of the ration fed and the market price of the materials used. It has been found by a series of tests in New Hampshire that horses at work may be kept on a liberal ration of hay, bran, corn, gluten meal, linseed meal, cotton seed meal and other grains at a daily cost of from 17 to 22½ cents. As a rule oats are an expensive grain ration and therefore raise the cost of the feed when fed too exclusively. In most localities it is a simple matter to substitute a grain mixture for a part of the oats in the ration with a considerable saving in the cost. When suitable substitutions were made it was found that the average total cost of feeding stuffs for horses at work in New Hampshire was $74 per year. According to the experience of some of the Canadian feeders the cost of feeding and caring for a horse at work is 37c. per day. In Ohio work horses were fed at a cost of $84 per year, the daily grain ration consisting of 7½ pounds

each of corn meal and bran and each horse being allowed one ton of hay per year with 30 pounds of silage daily in the winter.

RATIONS FOR COLTS

Colts to be raised by hand should receive fresh, warm cow's milk with a tablespoonful of sugar to each quart of milk. This addition of sugar is desirable on account of the fact that mare's milk contains more sugar than cow's milk and less fat. For this reason it is not best to use milk which contains more than four per cent. of fat. Colts may be given a pound or less of suitable cow's milk five to ten times daily. Fresh separator milk may be substituted as with calves and some grain may be fed. Colts may be taught to drink in the same manner as calves within two months. Some feeders recommend the addition of one fresh egg stirred into the milk daily for the first few weeks. If the colts are to obtain their greatest development they should be fed grain as soon as they will eat it. For this purpose oats and bran are the best. Corn is not desirable for young colts since it does not contain sufficient protein. Colts should not be starved or underfed during the first year since then they will never reach their full size.

If brood mares are maintained on the range they should be moved from time to time since the feed may be poor in one locality and consequently the necessary supply of milk may run short. It is necessary also to look after the water supply. A little protection for the foals if possible is always desirable and, wherever convenient, good results are obtained from the use of a little forage to supplement the range grasses.

RATIONS

As is apparent from the foregoing discussion the rations which are fed to horses on farms, will vary greatly according to the supply of food stuffs on hand. While considerable variation in the quantity of the food used and in the nature of the food stuffs is actually observed on different farms nevertheless it is evident that some standard should prevail in this matter. In other words the horse in doing a certain amount of work should receive a certain amount of food to do this work without loss of weight. A few examples may be mentioned of rations which have been found effective and satisfactory for horses at hard work. In one case horses hauling coal were kept in good condition on a ration of ten pounds of oats and twenty-one pounds of Italian rye grass hay. When the hay in this ration was diminished by 2 pounds the horses lost weight. This indicates quite closely the feeding requirements of the horses in question. In Kansas City draft horses are successfully kept on a ration of twenty pounds of corn and twenty pounds of hay. This ration, however, might probably be somewhat reduced. In the same city other companies keep their horses on a ration of 4½ lbs. corn and 6½ lbs. oats morning and noon with 6 lbs. of wheat bran at night and 20 lbs. of hay per day. In California horses are kept at light work on a ration containing 9 to 15 lbs. alfalfa hay, 9 to 11 lbs. wheat or barley, 6 to 7 lbs. corn. It is an evident fact that too little attention is given to the proportioning of rations. This matter requires as careful study as in the case of dairy cows or other animals. The kind and quality of foods should be noticed and the ration

balanced more or less accurately according to their content of protein and carbo-hydrates. Where timothy and oats are too expensive various other substitutions for these materials should be made as suggested above. Many of these substitutions not only reduce the cost of the ration but increase its effectiveness.

Feeding Mares.—Previous to foaling and especially after foaling mares should be fed grain and green feed with a view to producing a large milk yield. The more milk produced by the mare the better the development in the colt. In this respect the colt is on the same basis as the lamb, calf or pig. For the production of large amounts of milk a relatively narrow ration is indicated. For this purpose clover and alfalfa should be fed in the place of timothy and a relatively nitrogenous grain ration should be given, accompanied by bran, cotton seed meal, barley, peas, or other similar material depending upon the market price of such feeding stuffs. While the colt is sucking the mare, some care should be exercised to prevent the feeding of materials which could unfavorably influence the milk, and thus affect the colt. Even when mares are on the best of pasture they should receive some grain feed in order to keep up the milk yield to its highest point.

Feeding Stallions.—Similarly with the stallion the object should be, especially during the season of service, to give him feeds which contain a relatively high percentage of protein, as well as other materials which make the ration as a whole somewhat laxative. Oats, bran, clean hay, crushed barley and green grass or other suitable material may be given but corn and Kafir corn or other highly carbonaceous foods are not indicated during this time.

The digestive capacity of the horse as compared with the cow is quite small. On this account horses should not be overfed at any time since otherwise there may be a loss in undigested feeding stuffs and colic may result. In some experiments instituted for gaining light on this point it was found that by reducing the amount of hay the percentage of colic was considerably lowered. The grain ration in such cases may be increased and the hay ration diminished so as to increase the effectiveness of the whole ration without increasing its cost. Most investigators claim that horses are unable to digest their feeds as completely as cattle or sheep. Such a statement is probable when it is remembered that the feeding stuffs do not remain as long in the stomach of the horse as in that of the ruminant. In tests of this matter in Utah, however, it was found that horses make as good use of their feed as cattle, and that in general they are as easily brought to maturity as steers. Since the market price of the horse is partly determined by the weight of the horse, it is desirable to know the cost of the gain in horses in order to estimate the economy of raising horses for market. Very few careful experiments have been made with this idea in mind. It appears, however, that the cost of gain in colts is about 6cts. per pound and as long as the developing colt does not cost much more than this there is considerable profit in horse raising.

Injurious Feeding Stuffs.—Attention must always be given to the quality of the forage and grain fed to horses in order to detect any injurious qualities in these materials. Ergot occurs on the seeds of many grasses and on rye. If fed during long periods this fungus causes serious disease in horses. Numerous plants are known to be poison-

ous to horses. For example the common horse tail, golden rod, lupine, loco weed, larkspur, rattlebox, aconite, etc. These plants can only be obtained by horses in native pastures or on uncultivated lands. They furnish argument for a suitable system of rotation by which all pastures are plowed and planted to some cultivated crop at frequent intervals. In this way harmful weeds are kept in check. In addition to the poisonous plants already mentioned, mustiness of all forage plants must be mentioned as dangerous to horses. Musty corn, corn smut, oat smut, wheat smut and rusts of these cereals are calculated to render the forage in question unsuitable or even dangerous to horses.

Care of Horses.—It is unfortunately true on a large percentage of farms that horses receive less care than other farm animals. When it is remembered, however, that it is desirable to keep them in condition for work as long as possible and at any rate for a much longer period than other farm animals are kept, the necessity of proper care and hygienic arrangements becomes evident. Not only should the forage materials be clean and of the best quality as just indicated but the water supply must be pure and carefully supervised. Horses are subject to a number of infectious diseases carried in water and various forms of colic and other digestive troubles may be produced by impure water. If running water is used in the pasture or in the stable it is necessary to have the trough constructed in such a manner that it can be easily cleaned and so as to exclude filth to as great a degree as possible. Box stalls may be constructed of two inch by six inch stuff placed in a vertical position and spaced about three inches apart. In

order to maintain as cleanly conditions as possible the feed boxes may be so constructed as to face outward except at feeding time. They may thus be easily cleaned. Ventilation must always be carefully provided for in the construction of stables. Bad air predisposes horses to catarrh and other respiratory troubles and generally unsatisfactory conditions. Domestic animals readily endure a rather low temperature, provided their shelter in other respects is satisfactory. It is more desirable to have pure air in the horse stable than to get a high temperature in winter with all of the accompanying undesirable conditions such as undue content of moisture, carbon dioxide and other stable gases. In providing for ventilation impure air may be most easily removed through the roof while the cold air may be drawn in from the side at a distance from the ground. The matter of lighting should also receive consideration in the construction of stables. Many cases of eye disease in horses are produced by improper lighting. Horses which are kept in dark stalls are subject to great changes in the intensity of the light in passing from such dimly lighted quarters into the bright sunlight. The more light in the stable the better, provided the direct rays of the sun do not strike the horse in the face. The best results are obtained under uniform temperatures by having the horses' stalls on the north and west sides of the barn rather than on the east and south sides.

In order to obtain the best results from horses it is absolutely necessary to give immediate attention to all ailments which may develop in them. This applies not only to serious ailments but to all slight troubles such as sore shoulders, collar galls, sore mouth, wounds, scratches, uneven develop-

ment of the feet, cracking of the hoof, lameness, etc. Some of the common diseases of the horse are briefly discussed below. If any trouble appears which is not familiar to the farmer or horseman a qualified veterinarian should be called at once. In serious cases of tongue lolling it has been found that this defect may be cured by amputating the tip of the tongue. This, however, requires the attention of a veterinarian. About three inches of the tongue may be removed without any danger and without diminishing the usefulness of the tongue in the least. In simple cases of tongue lolling a change of bits may bring the desired result.

The average age at which the horse ceases to be of great service is perhaps 20 years. They occasionally live to the age of 40 or 50 and quite often beyond 30 years. Frequently they are capable of considerable work up to 30 years. In individual cases mares have produced 32 colts and thoroughbred mares are usually bred up to the age of 22 and draft mares to 15 to 18. As a rule stallions are not considered suitable for service beyond the age of 20 years.

DISEASES OF THE HORSE

It is obviously impossible in the space at our disposal to give even a brief description of the numerous diseases which may affect the horse. Attention may be called to some of the most important and common ones with suggestions as to what may be done in different cases. In general it should be remembered that congestion, inflammation and fever are mere symptoms of disease and should always suggest investigation to determine the cause of the trouble.

In the first place we may mention some of the more important infectious diseases of the horse.

Influenza is a contagious fever which causes great depression and is complicated with numerous secondary troubles. Infection from this disease is frequently carried in water but most horses become infected from exposure in dirty stables. After exposure a period of 4 to 7 days passes before the disease appears. The symptoms are high fever with a temperature of 104° to 107° F., stupor, dulness, hanging head, red color and inflammation of the mucous membrane of the mouth and eye. The pink condition of this organ is responsible for the name pink eye which is often applied to this disease. Pregnant mares are often caused to abort by influenza. One attack of the disease renders the animal immune. Horses are most susceptible at the age of 4 to 5 years and consequently in buying horses this constitutes another reason why those past the age of 5 should be preferred. While the appetite remains the horse should be fed small quantities of hay or grain and roots. To reduce the high temperature cold water may be applied by injecting into the rectum or small doses of Glauber's salts or bicarbonate of soda may be administered.

Strangles, also called distemper, is an infectious disease which is most frequently observed in young horses. As a rule one attack renders the animal immune. The disease is transmitted by direct contact with infected animals usually in barn yards, livery stables, and other places where large numbers of horses come and go. The symptoms are cold, dejection, thirst, staring coat, chills, rapid pulse, cough, discharge from the nostrils within two days after the outbreak of the disease. A swelling takes place in the jaw which is at first very

puffy and hot and later breaks and discharges freely. Light cases require little treatment beyond such care as is suggested for all sick animals. If the fever is excessive, it may be reduced by administering Glauber's salts in handful doses three times a day or niter in one dram doses every few hours.

Glanders, also known as farcy when occurring on the skin, is an infectious disease of horses of acute or chronic form and always or nearly always results in death. On account of the fact that this disease may be transmitted to men in a fatal form and on account of its rapid spread among horses it is always necessary to kill and bury or burn all horses found affected with it. The symptoms of glanders are a continuous or intermittent discharge from the nostrils, ulcers on the mucous membrane, cough, swelling of the maxillary glands at the corners of the jaw and in some cases the development of numerous swellings and ulcers at various points on the body, particularly on the legs. This disease is transmitted by contact, by drinking water from infected places or by eating from infected mangers. No treatment for the disease is successful and as already indicated none should be undertaken.

As stated above horses are subjected to a considerable number of diseases affecting the digestive organs. If any difficulty in eating is observed the mouth and teeth should be carefully examined at once. It may be that some sharp pointed particles of the forage have penetrated the mucous membrane causing canker-sores or ulcers. This may be cured by swabbing with a solution of borax, nitrate of silver, carbolic acid, or any powerful antiseptic. The mouth should also be examined for the possible occurrence of irregularities in the

teeth. Occasionally the teeth do not wear smoothly, but show points on the outside of the upper jaw and on the inside of the lower jaw. In such cases the tongue and cheeks may be greatly lacerated at these points. If such sharp points are present they may be readily filed or "floated" off. Indiscriminate floating of horse's teeth, however, under all conditions is greatly to be deprecated.

One of the imaginary troubles of the horse is commonly called lampas. This name is given to a swelling of the hard palate immediately back of the incisor teeth of the upper jaw. It appears in all horses and ordinarily does not indicate any bad condition whatever. It was formerly the case that when any trouble occurred in the appetite of the horse this hard palate was lanced in one or more places in order to reduce the swelling. It is quite unnecessary to say that such treatment does not give the desired effect.

Colic.—This is a disease which is very frequently met with in horses. It may occur in a number of forms but one of the most frequent forms is known as spasmodic colic. In such cases the disease begins suddenly, the horse may stop suddenly, paw and show signs of abdominal pain. He may begin to plunge and roll at once. After the first attack is over he appears to be at ease for some time, but the attack recurs subsequently at shorter intervals. In cases of spasmodic colic, chloral hydrate may be given in water in doses of one ounce or Indian hemp in similar doses. Some horsemen have excellent results from the use of two ounces of sulphuric ether and two ounces of alcohol in water. If the violent symptoms recur the second time the dose may be given every hour or so. Another common form of the disease is known as flatulent

colic, caused by anything which tends to produce indigestion. The symptoms develop more slowly than in spasmodic colic. The horse appears dull, but does not lie down or plunge. Signs of bloat soon appear, and if not relieved as soon as noticed, the horse is in a dangerous condition. In this form of colic charcoal may be given in any quantities. Chloral hydrate may also be administered in one ounce doses in water and a physic is indicated such as Barbadoes aloes or turpentine in rectal injection of one or two ounces.

Constipation in horses is ordinarily due to feeding improper rations and may be readily relieved by adding laxative foods to the ration such as alfalfa, sugar beets, or various other materials. If the constipation is of a more serious nature, some laxative drug may be given, Barbadoes aloes being one of the best for this purpose.

Diarrhœa on the other hand may be due to feeding too large quantities of alfalfa, sugar beets, or other laxative foods and may usually be cured by reducing these materials in the ration and adding other substitutes like rye-bran, timothy hay or similar materials which have a slightly constipating effect.

Bots in horses is usually considered a more serious trouble than it really is. The bot fly lays its eggs on the shoulders and front legs of the horse from which they are licked off by the horse and later hatch and develop in the stomach. They sometimes appear in great numbers upon the inner coating of the stomach. Occasionally they may cause irritation of the stomach, but as a rule such is not the case and they ultimately reach their complete development and pass away in the feces. Various other parasitic worms occur in the intestines

of the horse, particularly stomach worms, but these troubles are quite insignificant and readily yield to treatment with vermifuges.

Ring Worm.—The general symptom of this trouble is the formation of circular scabby patches where the fungus becomes established and where the hair falls off. Finally the spot becomes quite bald and a disagreeable odor is emitted from it. This trouble may be best treated by washing the affected spots thoroughly with soap and hot water after which they may be painted with iodine or some other strong antiseptic.

Wounds.—Wounds in horses require considerable attention since they may lead to tetanus or blood poisoning. If properly cleansed on the other hand they heal rapidly without persisting as a running sore. In the treatment of wounds suitable antiseptics should be freely used. For this purpose bichloride of mercury, one part to one thousand parts of water, two to five per cent. solution of carbolic acid, two to four per cent. solution of boric acid, two to five per cent. solution of creolin or lysol, are to be recommended. If powdered antiseptics are preferred iodoform may be used. It is desirable that wounds be attended to at once not only on account of the danger of infection, but also because they are likely to be rubbed by the harness in working and thus become sores irritating to the horse. All such worry causes loss in weight and requires an additional amount of feed to balance it.

Azoturia.—In mild cases of this disease the trouble may appear as a lameness in one leg, the membranes of the eye and of the nose are of a dark brown color and some tenderness is shown when the last ribs are touched. The nostrils may become dilated,

the skin shows a heavy coating of perspiration and the animal soon falls to the ground and moves the legs convulsively. Such cases may result fatally within a few hours and in all cases of azoturia treatment is only partly successful. The disease may be prevented to a great extent by giving the animal a reasonable amount of exercise during the days when it is not at work. In other words, azoturia is caused in most cases by feeding the usual working ration to the horse at rest.

Lameness.—Horses are subject to a great variety of lameness in the shoulders, hips and legs. It is obviously impossible to describe all of the causes which may cause lameness. In some cases it is due to the development of splints which are bony enlargements of the cannon bone between the hock and the fetlock joint, side bones on either side of the coffin bone in the hoof, spavin a bony enlargement of the hock joint, ring bone and various other diseased conditions in the bones of the leg. It is an extremely difficult matter after the initial appearance of lameness to locate the cause, and treatment in all cases, in order to be effective, must be applied in the right manner and at the right place. It is desirable, therefore, to call in the services of a qualified veterinarian since by unskillful treatment the lameness may be increased or the horse may be kept out of commission for a much longer period than is necessary.

CARE OF THE HORSE'S HOOF

As a rule the farmer does not shoe his own horses, but depends upon the skill of some blacksmith whom he considers as qualified to do this work. Some points in the care of the hoof, however, may

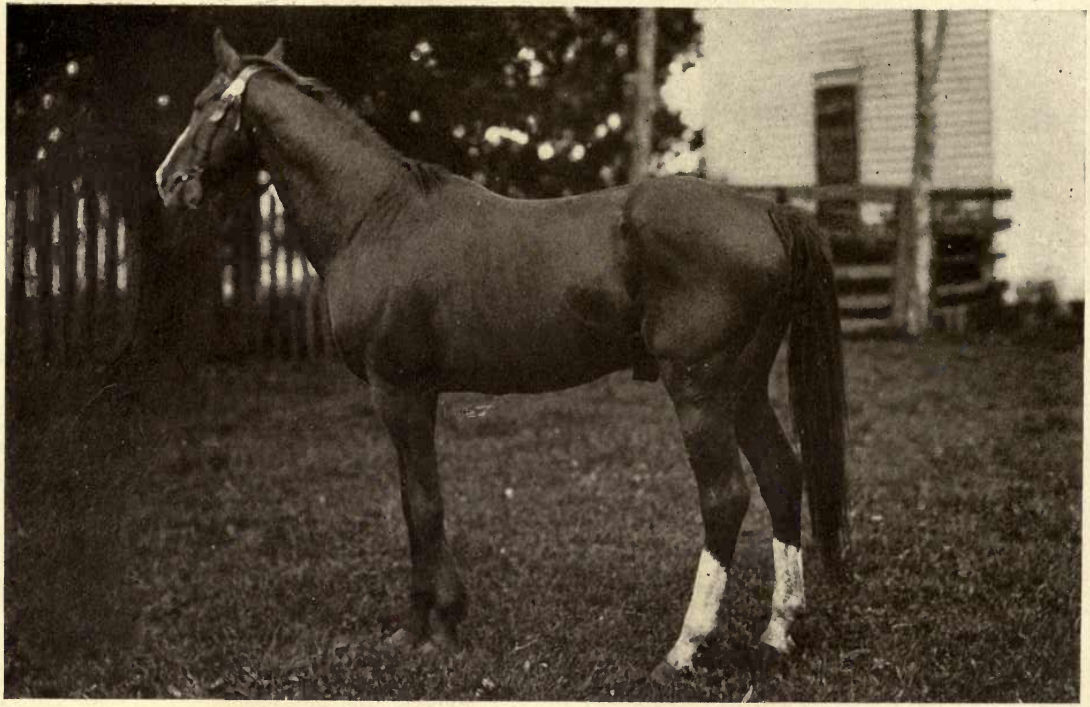
well be attended to by the farmer. It should be remembered that the hoof grows at the rate of one-third of an inch per month. Hoofs on the hind feet grow faster than those on the front feet. It is necessary that the hoof be kept trimmed in such a manner that contact with the ground will be uniform and will not cause the splitting of the toe or other parts of the hoof. Attention should be called particularly to young colts. When kept in the stable without abundant exercise they cannot wear down their hoofs and consequently the cleft of the frog should be cleaned out every few days and the whole hoof washed thoroughly. The outer edge of the hoof should also be rasped whenever necessary so as to secure symmetrical development. Horses should not be kept exclusively on dry planks since the hoofs may become too dry and inclined to crack and grow too slowly to prevent irregularities after shoeing.

BREAKING AND TRAINING HORSES

This is a matter which cannot be discussed in detail in this connection since the manner of training and the methods adopted in breaking will necessarily vary greatly under different conditions. Horses intended for saddle purposes, trotters, roadsters, coachers, etc., obviously require long and special training during which attention must be given to numerous details in order to secure the right style and finish. This is an art which can only be learned after considerable experience. Draft horses and ordinary farm horses, on the other hand, require but simple training since in these cases the gait is much less important.

In all cases where possible, breaking and training

should begin in early colthood. Young colts may readily be halter broken and as they grow older may gradually be accustomed to the bridle and other parts of the harness so that all these matters are familiar to them by the time they are ready for use. It is necessary in all cases to be kind and patient, but firm. The horse must be mastered at first and must recognize from then on that he is under the orders of the man who is breaking him. If it is inconvenient to train colts gradually during very early life the breaking of a fully developed animal is a more serious matter. In such cases it is usually necessary to devote some time exclusively to each horse, teaching them the meaning of the halter, bridle, harness, wagon and other objects with which they must come in more or less intimate contact. It is always necessary to show the horse that there is no danger in a number of objects which commonly cause fright on the street. Among these mention should be made of open umbrellas, moving bits of paper, and similar things which will occur to every farmer as common objects of fright to horses.



Courtesy of Virginia Polytechnic Institute.

THOROUGHBRED STALLION—THE FOUNDATION RACE OF ALL SPEED HORSES.

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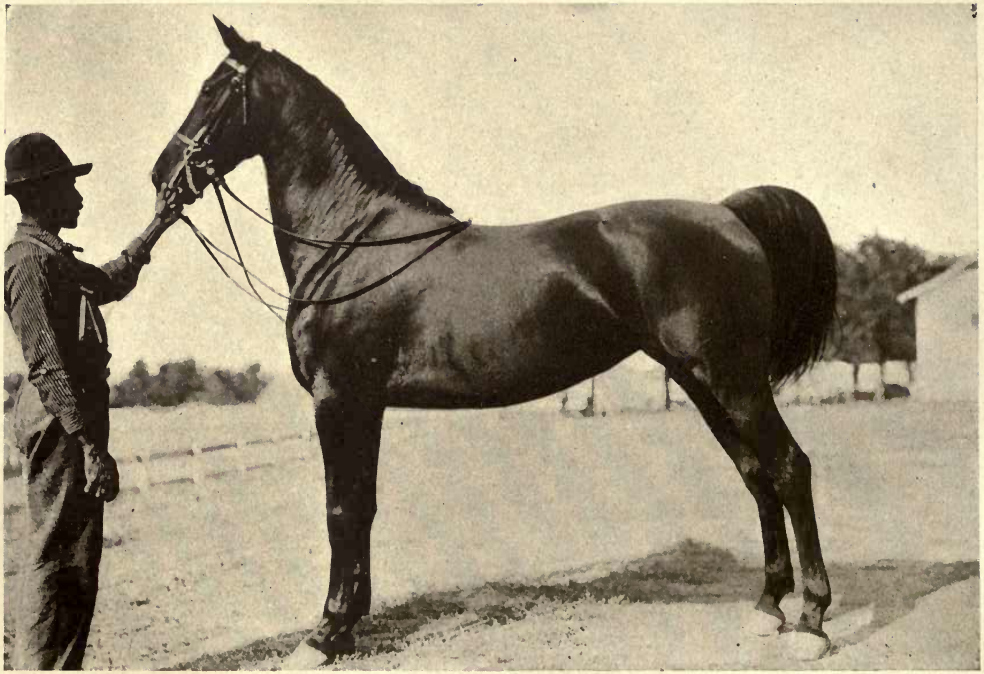


Courtesy of Division of Publications, U. S. Department of Agriculture.

AMERICAN SADDLE HORSE.

CHAPTER II.

THE MULE

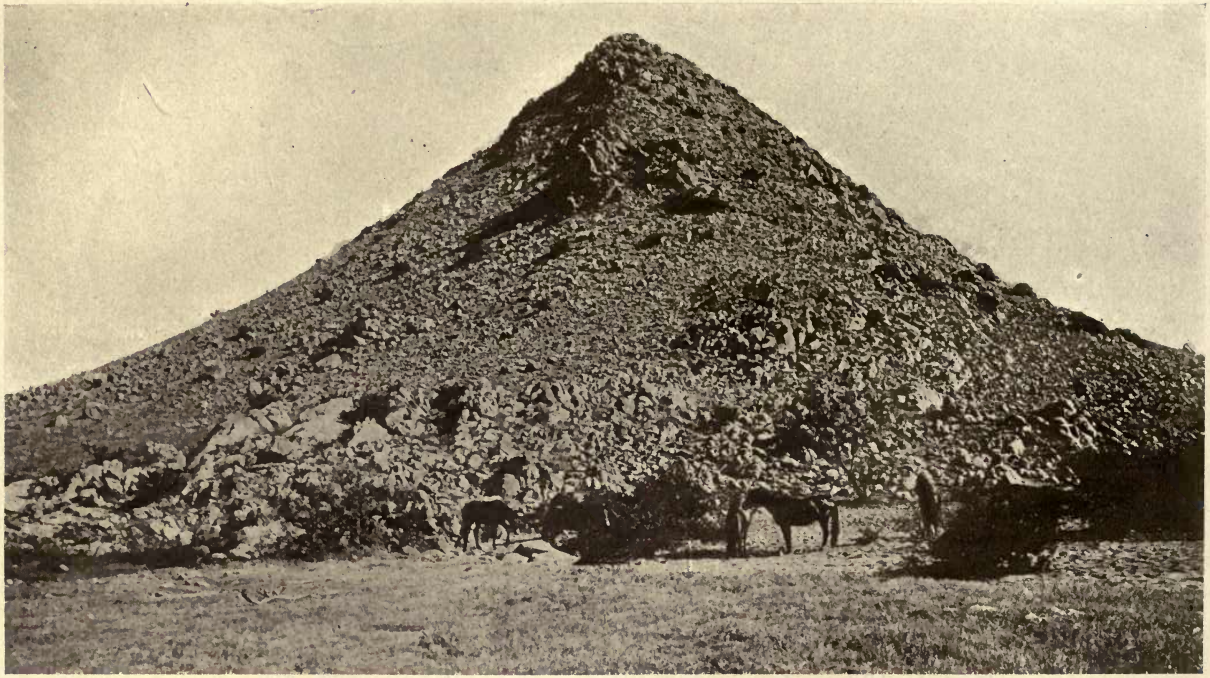
As is generally known the mule is a cross between the jack or male ass and the mare. The opposite cross, or that between the stallion and the jennet or female ass, is known as the hinny and is also quite frequently met with. In general, the mule is considered quite superior in all respects to the hinny and is almost the only hybrid form between the horse and the ass which is used on a commercial scale. It is a curious fact that while all species of the horse genus readily cross with one another and produce hybrids, all of these hybrids are sterile. Thus hybrids are known between the horse and ass, zebra and quagga. None of these hybrids have ever been known to produce offspring. Occasionally claims have been set up regarding the existence of fertile mules, but such claims have proved to be unfounded. The cross between the mare and the male zebra is known as the zebroid and has been experimented with quite extensively in England and Brazil. Furthermore, recently the Bureau of Animal Industry has begun some experiments along this line. From observations of the zebroid in Brazil claims have been set up that this hybrid is more graceful than the mule and more docile. However that may be, the only important hybrid between the horse and the ass, so far as we are concerned, is the mule.

In order to breed mules successfully it is desirable to know something of the different breeds of jacks which have been used for this purpose.

Poitou Jack.—We may start with this breed which originated in France and has been used in the production of mules for many years. At present more than 50,000 mares are used exclusively in France for mule breeding and this breed of jack is almost the only one concerned. The Poitou jack was the last breed of jack to be imported into the United States. His head is very large with comparatively small mouth and large ears. The chest is unusually broad and the abdomen large. The bones of the legs and feet are large and this point is of importance in mule breeding since the most important parts in so far as the jack is concerned is to gain as much size and strength as possible in the mule. The Poitou is perhaps the most powerful of all breeds of jacks and on account of the recent demand for them in mule breeding the price has been driven to extremely high figures, the ordinary figures being about $1200 and occasionally reaching as high as $3500. The prevailing color of the Poitou jack is a black or dark brown, and this is the color chiefly desired in mules.

The Andalusian was the first breed to be imported into the United States. It comes from the southern part of Spain, is gray with an occasional black or brown. On account of its color it is not so popular as the dark breeds of jacks for mule raising. The height is about fourteen and one-half hands and the legs are of fair size and strength.

The Maltese jack comes from the island of Malta and was the second breed to reach the United States. They are the smallest of the Spanish breeds, rarely standing higher than four-



Courtesy of Division of Publications, U. S. Department of Agriculture.

HORSES DIGGING HOLES IN THE BED OF A CREEK TO GET WATER.

They will dig holes three to four feet deep.

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A GROUP OF TWO- AND THREE-YEAR-OLD JACKS.

Black ones with white points are preferred.

teen hands. The color is brown or black. Some breeders who desire small jacks in mule raising speak well of the Maltese.

The Catalonian also comes from Spain, having been imported into the United States by Henry Clay. The color of this breed is uniformly black or brown, and on account of the strength, size and action of the Catalonian he stands in favor among many mule breeders. The Catalonian is at the foundation of our native jacks and has been used quite extensively for mule breeding in Kentucky and elsewhere.

The Majorca, from the island of the same name, is a strong legged, comparatively heavy type. The color is black or brown, like the Catalonian, and as a rule the Majorca is somewhat taller than the latter breed. It is believed that this breed by proper attention could be induced to develop even greater size than it has at present and thus increase its value in mule breeding. This cannot be done in the United States, however, since we have no pure bred females of this breed and the demand for them is so great that they can scarcely be procured.

The Italian is a small breed, rarely standing fourteen hands high, raised all over Italy, but not much improved. In fact little systematic attention has been given to the breeding of this animal. According to the experience of some mule breeders, the Italian jack, while a successful mule getter, is frequently vicious.

The native jack is, in the opinion of most mule raisers in this country, by all means the most desirable breed for use in the production of mules. The native may show all colors since it is really the product of a crossing of all the imported breeds. Within recent years, however, attention has been

given to the fixing of a black color in the native jacks so that at present this color prevails. The native jack is healthy, has larger legs and feet than the imported jacks and on this account transmits the most desirable qualities to his mule colts.

In breeding for mules it is necessary to select not only a good jack, but also a good mare. Most breeders, however, consider that the best jacks should be used in the production of jacks and not in mule raising. Two classes of jacks are thus established and are frequently referred to under the names Jennet jacks and Mule jacks, according as they are employed in the production of jack or mule colts. The mare used for raising mule colts, or, as she is commonly referred to, the mule mare, should be of good form, without defects and of a black, brown or bay color so as to give the desirable dark color to the colt. Ordinarily the mule inherits the form of its ears, head, tail and legs from the jack and the size and formation of the body from the mare. Since this statement is based on the extensive observations of mule breeders, it is obvious that the desired results can only be obtained in mule raising by giving proper attention to the form and size of the jack and mare.

The mule can be used for almost all kinds of work ordinarily performed by horses and furthermore possesses certain decided advantages over the horse. In mines mules far excel horses in the amount of work they can do and the hardship they can endure. Moreover, as pack animals the mule is universally recognized as superior to the horse. In our military organization the army mule has long been famous and those who have had extensive experience with mules, as for example Riley and others, are unanimous in the

opinion that the mule can do more work under longer hours and in more trying circumstances and with greater hardship than the horse. It is not true, however, as sometimes asserted, that the mule eats less than the horse. On the contrary the mule has an excellent appetite. However, the mule can go longer without food and can live on coarser and more unpalatable food than could be expected to give results with the horse. Contrary to a prevailing belief also, the mule is equally susceptible to various diseases as the horse. In the Philippines our mules suffered as much as horses from surra. Glanders has always been dreaded as one of the scourges of the army mule. Even colic and other digestive troubles familiar to horse raisers also occur among mules.

The jack may begin service at the age of two years, but should not be allowed to reach a maximum until he is mature. With mules also it is a mistake to put them to work before they are fully mature. Many of our military authorities have had serious trouble in attempting to put three-year old mules at a maximum of work. At this time the milk teeth are being shed and replaced by others and they are unable to eat enough to keep them in strength and condition. While the mule is usually sold on the market just after two years of age he should not be put to work at full rate until five.

THE FEEDING OF MULES

As would naturally be supposed the mule can be fed on the same materials and in about the same rations as the horse. Time of feeding and the method of giving the food should also be the same. A large number of experiments have been carried out, especially in the southern states, Jamaica, South

Africa, and France, and from these experiments a number of reliable and valuable data have been secured. It appears, for example, that mules may be kept through the winter when not at hard work on an exclusive cotton seed ration, four or five pounds of cotton seed meal and all the cotton seed hulls the animal will eat. If the above ration is adopted the mules should receive salt and water in the same quantities as required by horses. In the southern states it has been found particularly desirable for the ration to be always slightly laxative or, at least, not constipating since under such circumstances an irritation may appear on the skin leading to a disease called jack sores.

Mature mules can be kept at work on an almost exclusive ration of corn. During growth only small amounts of corn should be fed in the nitrogenous ration. Bran and clover hay may be considered a suitable part of the ration in order to prevent it from becoming constipating. Hay may be given in self feeders or otherwise given ad libitum. Throughout the South and in South Africa, molasses is a common mule food as well as an important ration for horses. It is fed to mules in rations of six to twenty pounds per day. In some cases it has been found to bring an excellent finish to the coat and to prevent colic in mules to an extent which has not been secured by other methods. Cassava, sweet potatoes, wheat hay, cowpea, silage, clover hay, corn stover, oats, gluten meal, bran, pumpkins, roots of all kinds and various other grain and forage crops are as readily digested and utilized by mules as by horses. The danger from colic should always be borne in mind. Thus with feeding cotton seed meal it is well to begin with a ration of one to two pounds per day, grad-

ually increasing to six pounds which should be the maximum. The meal should always be yellow and unfermented. Occasionally it is noticed that mules do not relish cotton seed meal.

In fattening mules for market slightly different methods are practiced, depending on the class of the mule. The two market classes of mules are sugar mules and cotton mules, the sugar mules being larger and the cotton mules smaller, but both of the same conformation. The sugar mule is put on a fattening ration in November and brought to a weight of 1150 to 1350 pounds by the first of September, after it reaches the age of two years. The feed during this time should consist of mature corn in the ear, clover and alfalfa, sheaf oats, bran and other green forage. Oats and bran are considered as essential in producing the proper market finish. Cotton mules are put in the stable during the August after they reach two years of age and fed in about the same manner as sugar mules with the idea of getting them in the market by the first of January, when the cotton mule market opens.

As an example of what may be expected from mules in the way of work and in feeding requirements, we may mention a team of mules in Oklahoma which was worked seven hours per day. During the year this team ate forty-one bushels of Kafir corn, seventy-three bushels of corn, forty-three and one-half bushels of oats and four hundred and forty-five pounds of bran, at a total cost for the grain of $36.40. At the same time the mules consumed four tons of Kafir corn stover and four and a half tons of hay worth $26.00. The whole cost for the year was therefore $62.40 or seventeen cents per day for the team of mules. In spring the mules drank one hundred and seven pounds of water per day,

and in hot weather as much as one hundred and thirteen pounds each. When not working, however, especially in cold weather, the amount of water required per day was often only eighteen or twenty pounds for each mule. These mules did one third more work than horses and ate less grain, but rather more coarse fodder. These differences between horses and mules are such as are ordinarily found. The mule, while patient and possessed of great endurance, especially toward all kinds of neglect, nevertheless has an excellent appetite and will eat rations corresponding to those required by a horse of the same size. His appetite is not so delicate as that of the horse and consequently he may be induced to eat more coarse and undigestible food than the horse will. The extent of the mule industry and its importance may be seen from the fact that according to the last census there are nearly 3,500,000 mules in the United States. This industry is rapidly spreading. In former years it was largely confined to the southern states, especially Texas, Mississippi, Kentucky, and Tennessee. Recently, however, it has developed so as to include not only those southern states and others, but many of the northern states. In fact at the present time some of the largest mule raising ranches in the country are located in the northern states, and the Chicago and other northern markets for mules are very important centers of traffic in these animals. In Jamaica, the importance of the mule industry has been the cause of considerable neglect in horse raising so that a governmental investigation was necessary to determine means of improving the horses of the country.

In the breeding of mules a large number of

jacks are kept and used for no other purpose. The mule breeders of the country have realized the importance of improving the mule as well as other stock and have organized a jack and jennet association with a registry of about 1,400 animals. It has been found that jack colts are best weaned at the age of six months. They are fed plenty of nitrogenous material such as oats and bran with hay and an abundance of green forage. The percentage of mule colts obtained from jack service is about one half or approximately the same as is the case with horses. In breeding jacks it is always to be remembered that there is some aversion on the part of the mare and in many instances the jacks may appear to be afraid of the mares. It is, therefore, desirable to use a pit or chute in which the mare can be confined so as not to injure the jack. As already indicated the market requires a dark colored mule. White, gray and mouse colored mules are not desired and many stories are told by army officers and others to the effect that mules of these undesirable colors are less hardy, more susceptible to disease than dark colored mules. However that may be the public demands a dark mule and this is the end of the matter. It is desirable, therefore, to use dark mares and dark jacks in order to secure the proper results.

Much controversy has raged around the point of the proper size for jacks. Some breeders would not use a jack above fourteen hands in height, arguing that since jacks have comparatively small legs and transmit these characteristics to the mule colt it is impossible to secure proper proportion in mules if too much height is obtained. In other words mules with large bodies inherited

from the mares on slender, spindling legs are certainly not desirable animals for use. Such results are not always obtained, however, and recent practice is to use as tall jacks as can be obtained provided they have the proper strength of bone in the leg. Since the size of the mule as a whole seems to be inherited from the mare, it is a very important matter to use the right kind of a mare. Some breeders use Percheron mares and jacks fifteen and two-tenths hands high with heavy bone, deep chest and long body.

As with other animals so with jacks, the best results are obtained after they reach maturity. Mature jacks are more certain of getting foals than young jacks and transmit a greater hardiness to them. The spring is usually preferred as the time for breeding. All mules are strictly sterile, but in order to secure the proper docility it is necessary to castrate male mules and this should be done at one year of age. As a rule female mules are preferred to males for the reason that they mature rather more promptly and develop a better form than the males.

Mules are to be broken in the same way as horses. While many mule raisers insist upon it that these animals are incomparably more stubborn and vicious than horses, requiring much care and a great deal of harsh treatment to secure obedience, the exact opposite is claimed by others. Some mule breeders maintain that with ordinary kindness, especially with some attention while the colts are young, no more trouble need be experienced in breaking and handling mules after they are broken than with horses.

Hinnies, or the hybrid between the stallion and the jennet, have never been much used in this

Courtesy of Texas Experiment Station.

BROOD MARE AND HER MULE COLTS, IN TEXAS.

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MULES AT HOME ON THE FARM—PLOWING UNDER COWPEAS.

country. The statement was long ago made on fairly good authority that hinnies are weak, lack hardiness, and are far more stubborn and vicious than mules. Recently, however, in Jamaica some breeders have come to the opposite opinion, finding that hinnies are better than mules for nearly all purposes. They are more like the horse than the jennet and show a more graceful head, and heavier mane and tail, inheriting these properties from the horse. The slight use to which hinnies have been put in this country makes it impossible to predict just how important they may become. If burro mares are crossed with thoroughbred stallions they have been found to produce a hinny of some speed, excellent temper, and good style and action and since the burro is nothing but a diminutive jack it is evident that not all hinnies are too cross and vicious to be managed. If trouble is experienced in breeding mules or if it is desired to breed a considerable number of mares at the same time, artificial impregnation may be adopted in the same manner as is practiced with horses. When this method is used no especial breeding chute or other device for confining need be arranged.

The main question before the farmer in undertaking a line of industry with which he is unfamiliar is with reference to the duration of the market and the prices of the product. In this respect it is impossible to see any serious difficulty in the immediate future of mule raising. As already indicated, they are being used more and more for almost all work ordinarily performed by horses, and mule-breeding establishments are springing up in the north and northwestern states for supplying the local and general market. Although

large numbers of mules are to be found in the stock yards of Chicago, Kansas City, St. Louis and St. Paul, all these animals are nevertheless grabbed up at remunerative prices so that there appears to be no danger of overstocking the market. The price for average mules is almost always higher than for average horses and the fact that they are marketed at two years rather than five years is an important consideration in the matter of time and feeds. At present, under proper management, the profit from raising mules and marketing them at two years of age is more than twice as great as that from raising horses and marketing them at maturity or 5 years of age.

MULES FROM PERCHERON MARES—SHOWING THE COLOUR AND FORM OF THE DAMS.

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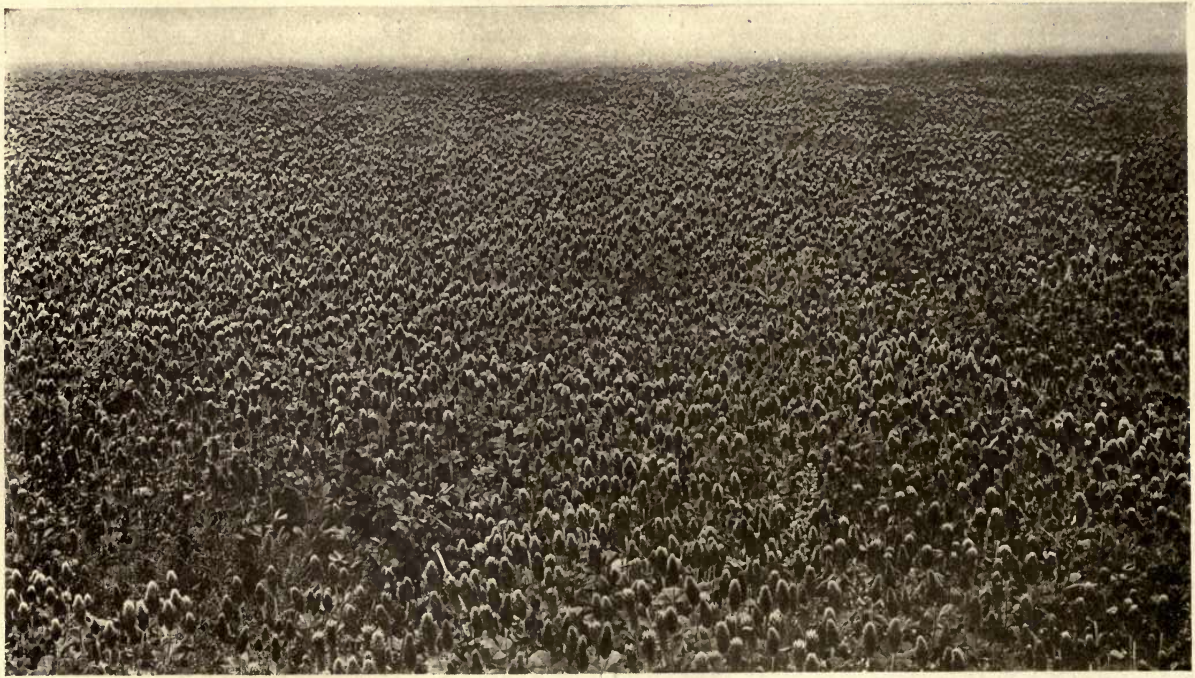


Courtesy of New Jersey Experiment Station.

A FIELD OF CRIMSON CLOVER.

One of the best plants for producing protein on the farm.

CHAPTER III.

BEEF CATTLE

In recent years an unusual interest has developed in the beef industry, partly on account of the great advance which has been made in the scientific feeding of cattle so as to obtain a better market finish and a better quality of beef, and partly on account of the changed market requirements and the breeding which has been done to bring about an earlier maturity of beef cattle. These improvements in the methods of beef production have been made necessary on account of the higher prices of land, of labor, and of feeding stuffs. In fact, at present the feeding of beef cattle for market has become a special line of work which requires a high grade of skill and thorough understanding of the feeding values of different materials used in the production of beef, as well as an appreciation of the requirements of animal nutrition, and shrewd business ability. Without these prerequisites, the feeder is doomed to receive very small returns for his labor or simply starts on the road to bankruptcy. The market requirements for beef at present are much higher than in former years. It is necessary therefore, in order to receive prices which remunerate the feeder for his time and feeds, to produce in his feeding a herd of cattle as nearly uniform as possible in appearance and quality and with a high market finish and symmetrical development, particularly in those parts which yield high-

priced cuts, in which the profits lie for the butcher.

During the early days of the cattle industry in this country steers were marketed at the age of five or six years, fully matured and only in fair condition as far as the quality of the meat was concerned. These animals might be of larger form and in many cases the actual weight more than that of the average beef animal brought to market at the present time. Such cattle, however, were not uniform in size, finish, frame or quality and, moreover, yielded a profit so small that as soon as the prices of feeding stuffs rose to their present standard the further raising of such animals became unprofitable to the farmer. In those early days the development of the cattle kings of the West took place. The cattle were hardy and were allowed to run on government land or upon open grass land held under the old Mexican land grants at practically no expense, excepting the salaries of a comparatively few cowboys and foremen. Under these conditions all chances were taken with the weather, disease, poisonous plants, and other emergencies which might arise. Nevertheless, under favorable conditions enormous profits were made. Later as the range became crowded and forage less abundant the cattle went into the winter in a poorer condition and in the case of an unusually severe winter died by the thousands. The losses which occurred in unfavorable winters, particularly in 1884, compelled the cattle men to adopt other tactics, such as investing in better stock, caring for them more attentively, feeding in winter, marketing in a better condition and at correspondingly higher prices. The sheep industry gradually claimed more and more attention on account of the large profits made from this business, and from 1885 until the present

time sheep have gradually been crowding cattle from the western ranges and reducing the number which is run under the old methods of the cattle business.

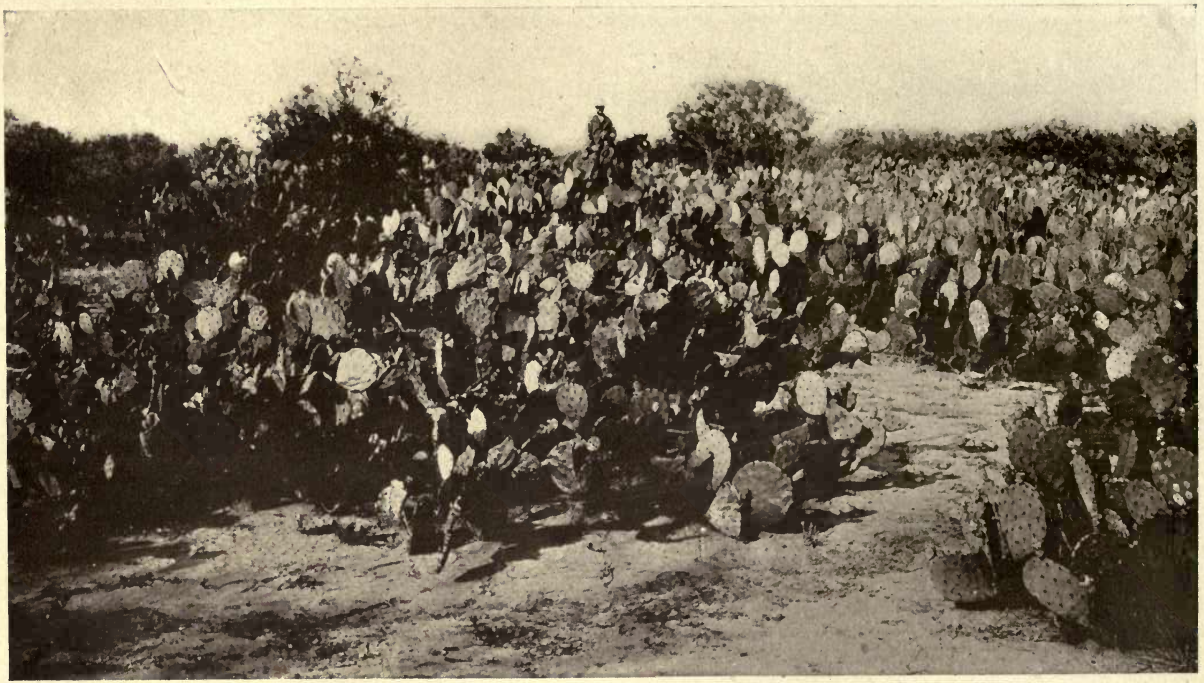
With the adoption of modern market requirements for the quality of beef, the old classes of beef animals went out of style and were replaced by improved beef breeds which would mature more early and produce a better style of beef animal. The propaganda, thus originated, spread first over the corn belt where the best quality of beef animals is still raised, but has gradually extended over the western ranges until the old Texas longhorn with his shaggy coat and lank frame has almost disappeared and has been replaced by Herefords, Shorthorns, Angus, Galloways, Red Polls, and other beef breeds with their grades.

According to the most recent estimates the number of beef cattle in the United States is 43,670,000. Of this number twenty per cent. are annually slaughtered for beef. The number of calves from beef cows raised to maturity is eighty per cent. During the year 1905, the total number of cattle slaughtered in the United States was 12,500,000 of which 875,000 were exported. The average value of the carcasses of these animals was $41.50.

In order to start in the business of beef production in the right manner, it is necessary to know something of the different beef breeds. Naturally it is impossible to make a choice in this matter for different persons, but some of the characteristics of the different pure breeds now produced in the United States may be given in order that the individual may choose from this list according to his peculiar conditions.

BREEDS

Shorthorn.—Undoubtedly the Shorthorn is the most popular at present of all the beef breeds. This statement is based chiefly on the number of registered Shorthorns which is considerably greater than that of any other breed and on the replies received by various experiment station authorities from representative farmers and beef raisers in different states. Shorthorns or Durhams are at present raised to some extent in every State of the Union. They were first imported to this country about 1790 and from 1835 on began to increase rapidly in popularity. In the American Shorthorn herd book 600,000 animals have been registered and in Canada about 65,000. Shorthorns readily adapt themselves to all kinds of climatic and agricultural conditions and weather and their hardiness is, at least, of medium grade. In size and weight they are rather superior to any other breed and in the early maturing quality they are equal to the Hereford and Angus which are their most prominent competitors. They become fully mature at 30 months and reach the limit growth at 4 years. On the range and on native pasture their grazing ability is medium. They are perhaps excelled in this respect by the Hereford and Angus. They make good use of their feed and lay on a thick fine coat of flesh on the outside of the frame. The quality of the meat is also excellent. One of the chief advantages in Shorthorns is their high milking quality. This breed is usually referred to as a dual-purpose breed since it is both a good milker and a beef producer. There are two general tendencies shown among breeders of Shorthorns, one being to produce an excellent quality of beef and



A JUNGLE OF PRICKLY PEAR ON A TEXAS RANGE—GOOD FORAGE WHEN THE SPINES ARE REMOVED.

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Courtesy of Division of Publications, U. S. Department of Agriculture.

FEEDING CANE-CACTI TO CATTLE AFTER SINGEING OFF THE SPINES.

the other to obtain a combination dairy and beef animal. We thus have the fat Shorthorn and the dairy Shorthorn. In grading up native cattle, Shorthorns have been widely used with good results. In some instances they have been found wanting in constitution and with a tendency to sterility on account of forced feeding and irrational treatment, particularly in breeding.

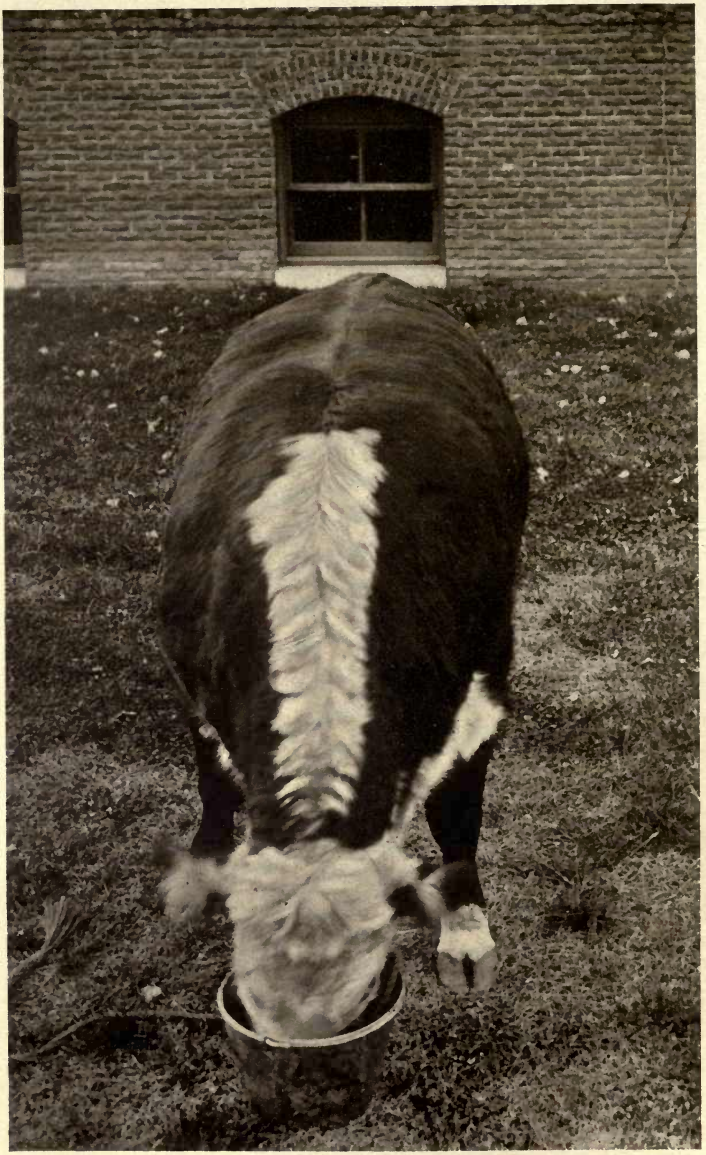
Shorthorns show in all respects the form and characteristics which feeders require in the beef type of animal. The outlines are those of a parallelogram, the back lines and belly lines being straight parallel lines and the side lines showing no pronounced tendency to converge in the hips and shoulders. The whole form is round and regular with a good coat of flesh over the whole body and all cavities well filled. The standard colors commonly recognized are red, roan, and white, red being preferred by nearly all breeders and cattle buyers. Roan is always an acceptable color in Shorthorns, but white is not a favorite in some localities. In fact judges occasionally discriminate against Shorthorn cattle showing this color.

Hereford.—In point of numbers this breed should come second to the above breed. The Herefords have been referred to in England since 1627 and were first introduced in the United States by Henry Clay in 1817. At present they are distributed throughout nearly every State and territory of the United States and most of the provinces of the Dominion of Canada. About 200,000 Herefords have been registered in America. This breed is almost equal to the Shorthorn in size and weight and is rapidly gaining in popularity. They readily adapt themselves to all

conditions and on the range are considered by many cattle raisers as more active and better rustlers than any of the other beef breeds. They mature at 30 months like Shorthorns and Angus and are, therefore, excellent cattle for the production of baby beef. The quality of the beef is unobjectionable. The amount of milk yielded by Herefords, however, is rather small. In color they are red and white; the ground color being red with white on the face and on the underline running from the throat along the lower part of the body. The tip of the tail is also white. The large white mark on the face gives them their popular name of White Face and the usual distribution of red and white produces a beautiful pattern. Recently a Polled Hereford breed has been established. It is identical with the standard Hereford excepting the absence of horns. Polled Herefords give much promise.

Angus.—The original ancestors of cattle were without horns and in their hornless condition the Angus, therefore, show the recurrence of the old character. They originated in the counties of Aberdeen and Angus in Scotland and their full name is a combination of these county names or Aberdeen Angus, commonly shortened, however, into Angus. This breed has been frequently referred to since 1735 and was introduced into the United States in 1873. The Angus thus came quite late as compared with the Shorthorn and Hereford and on that account had to establish a reputation for itself before it could become very widely distributed. At present the popularity of the Angus among those who know them is perhaps second to no other breed of beef cattle. They are largely distributed throughout the entire country

HEREFORDS — THE WHITE FACES ARE THE PRIDE OF THE RANGE.



Courtesy Nebraska Experiment Station.

HEREFORD STEER — A LIVING BLOCK OF BEEF.

and in Canada, but are raised in the greatest numbers in the central corn states, especially Iowa, Illinois, Kansas, Missouri, Ohio, and Indiana. Within recent years a large number of importations have been made and an increasing number of native stock has been distributed throughout the various parts of the country for the purpose of improving the grade of beef animals. In regard to their grazing ability, opinions differ quite widely and much bitter controversy has prevailed. According to some cattle men, the Angus is too indolent to become a good animal on the range. Others, however, insist upon it that the Angus is superior in this respect to the other breeds. The quality of the meat of the Angus is usually considered superior to that of the Shorthorn or Hereford and equal to its near relative the Galloway. One of the chief strong points of the Angus is its strong prepotency. The Angus bull, when used in grading up beef animals from native stock, transmits its characteristics to an unusual extent. In from seventy-five per cent. to ninety per cent. of cases the progeny of Angus bulls are black and hornless without regard to the color of the cow. In size they are slightly inferior to the Shorthorns and likewise in milking properties. In Scotland the Angus gives a fair amount of milk of good quality, but in America no attempt has been made to keep up the quantity of the milk in breeding. Attention has been given in this country entirely to the production of the finest possible quality of beef. The Angus appears to stand shipping by rail somewhat better than the other breeds of cattle. As already indicated the color of the Angus is black with an occasional occurrence of a narrow white line along the belly

behind the navel. The Angus is the first and most important of the polled or hornless breeds, both the Shorthorn and Hereford bearing horns, the latter being wider spread and larger in diameter than those of the former.

Galloway.—This breed, like the Angus, comes from Scotland and was introduced into Canada in 1853 and into Michigan in 1870. A Galloway breeders' register was established in the United States in 1882. At present this breed is distributed mostly in Iowa, Illinois, Missouri, Kansas, and Minnesota. The Galloways are gaining in popularity wherever they are raised. This breed is the hardiest of all the beef cattle with the exception of the West Highland cattle. The hair is long and wavy. In size they are somewhat smaller than the Shorthorn, Hereford, or Angus. Under ordinary conditions they do not mature as early as the Angus or Hereford, but may be readily forced by suitable feeding. The Galloways are excellent grazers and are capable of giving a good account of themselves under unfavorable conditions. The quality of the beef has been referred to as of unusual excellence, in England, for the past two centuries. The prepotency of the Galloway is perhaps stronger even than that of the Angus since from ninety-five per cent. to one hundred per cent. of the progeny of Galloway bulls from native stock are black and hornless. They are good breeders, but yield a very small quantity of milk. One peculiar value of the Galloway lies in their beautiful hide which is extensively used for robes and other purposes. On account of their long, wavy hair the Galloways are preferred in crossing with Buffaloes to produce the half breed known as the Catalo. The color

of the Galloway is black with a slightly brownish tinge. In general they are spirited. They closely resemble the Angus in appearance excepting for the possession of wavy hair.

Red Poll.—This breed comes originally from England and has been crossed to some extent with Shorthorns and West Highland cattle. It was introduced into the United States in 1879 and has been distributed in small numbers throughout the country. The Red Polls are a dual-purpose breed, yielding a large quantity of milk and are valuable, therefore, in the combination of dairy farming and the production of beef. They are capable of adapting themselves readily to our conditions and are somewhat smaller than Shorthorns, maturing at a medium early age and showing good grazing ability. They are of considerable value in grading up native stock to produce a better beef type. The color is a bright red with white on the tip of the tail and the udder.

Sussex.—This breed of cattle seems to be related in its origin to the Devons. Sussex cattle were first imported into the United States in 1884 and have never become very popular. There are only a few hundred registered animals in the United States at the present time and these are chiefly in Tennessee, Indiana, Oklahoma, and Texas. They are about equal to the Galloway in size and are excellent grazers, maturing rather early, and are good feeders. The quantity of milk is not very large. On account of the small number of Sussex cattle in the United States their qualities have not been thoroughly tested. The color is ordinarily a light or dark red.

West Highland Cattle.—This breed has long been known in Scotland and is sometimes

called Kyloes. These cattle have been sparingly introduced into the United States and have gradually spread into the West and British Columbia. They are the hardiest of all beef cattle and for that reason are recommended for ranges of the northwest United States, and British Columbia, and Alaska, where severe winters and violent climatic changes are to be met. They are capable of maintaining themselves in good condition on very poor range and for this reason are considered excellent beef cattle for some of the worn out ranges of the West. The quality of the beef is excellent. The amount of the milk is small. For grading up native cattle they have little to recommend them. Since their chief advantage is their hardihood this might be lost in the offspring from native cows. In size they are rather too small to compete with the leading beef breeds. The color is black, red, dun or yellow and the hide is covered with abundant, long, wavy hair.

Polled Durhams.—This breed of cattle is strictly a dual-purpose breed and yields a good quantity of milk. The Polled Durham originated in the United States, chiefly in Ohio, and came from native muley cows crossed with Shorthorns. They are, therefore, strictly hornless Shorthorns. The Polled Durhams have become gradually distributed from the middle West to the far West and other parts of the United States, and appear to be increasing in popularity. The standard of points for the breed is essentially the same as that required for the Shorthorns and the characteristics are much the same as in the latter breed, except in the one point that they are hornless. The quantity of the milk is perhaps somewhat greater than that given by the Shorthorn.

This completes the list of pure breeds of beef cattle in the United States, with the exception of the occasional introduction of some European type by a fancier without any definite purpose in view. There are a few specimens of Holderness cattle in different parts of the country, particularly in New York. This animal is essentially a variation of the Shorthorn and resembles it in most particulars, excepting as to coloration, which may show more irregular white spots than are shown upon the Shorthorn.

MARKET CLASSES AND GRADES

Sharp distinction must be made between market classes of beef animals and market grades. These differences have been drawn in a very satisfactory manner by the Illinois Experiment Station. The classes recognized include beef cattle, Texas and Western range cattle, butcher stock, cutters and canners, and stockers and feeders, and veal calves, while the grades usually recognized on the market are prime, choice, good, medium, common and inferior, referring obviously to the quality of the beef rather than to the form and condition.

Beef Cattle.—This class includes all grades of steers and heifers in the case of which serious efforts have been made to put them in proper market condition. The steers in this class range in weight from 900 to 1,600 pounds, depending on the grade. Prime steers should weigh from 1,200 to 1,600 pounds, and quality and condition are always important features in determining the market value of these animals. In this class we also have shipping steers which are

intended for the eastern and southern trade and export steers or foreign steers and dressed beef cattle which are bought chiefly by the large packers of Chicago and other beef centers. In the same class baby beef, distillers and Texas cattle are considered as distinct sections. They really belong, however, in the market class of beef cattle. Baby beef is the term usually applied to steers weighing from 800 to 1,000 pounds and between one and two years of age. Distillers is the term used to refer to cattle fed on the by-products of distilleries. The term arose from the fact that at first only poor grades of cattle were fed on these by-products. Recently, however, much better classes of cattle have been used for this purpose, chiefly because it has been found that cattle fed on distillers' grains and other by-products carry an unusually small amount of offal and a very high percentage of dressed beef.

Texas and Western range cattle is a term which requires no explanation since it refers to all western branded cattle in fairly good condition and finish, according to the method of feeding which prevails throughout the range country. These cattle are usually purchased as feeders, brought to the corn belt and put into a finished market condition by means of corn and other grains.

Butcher Stock.—This class is made up of the culls of beef cattle. However clever the feeder may be, it is well known that in selecting his stock some of the animals will fail to develop the best market condition or in other ways will not utilize the feed to the best advantage. Such animals are thinner than they ought to be and the fat is not as well distributed as in high-grade beef animals.

The larger part of this class is composed of tolerably fat cows, and heifers, and bulls which show many grades of fattening.

Cutters and Canners.—These include some of the thinner culls from beef animals. The grades of this class run from inferior to good, no choice animals being included in it. Some of the less desirable bulls in this class are commonly referred to as bologna bulls.

Stockers and Feeders.—This class includes calves, yearlings, two-year-olds, and other animals of both sexes. If the animals are intended for immediate shipment to the feeding lot they are known as feeders. If the age is eighteen months or more, calves, heifers, yearlings and steers are commonly known as stockers. As a rule animals which are intended for the feeding lot weigh from 900 pounds to 1,000 pounds. The weight of stockers may range from 450 pounds to 900 pounds.

Veal Calves.—The weight of the animals in this class varies from 80 pounds to 160 pounds and the main factors in determining the grade to which the veal calf belongs are age, condition and weight, but chiefly age and weight.

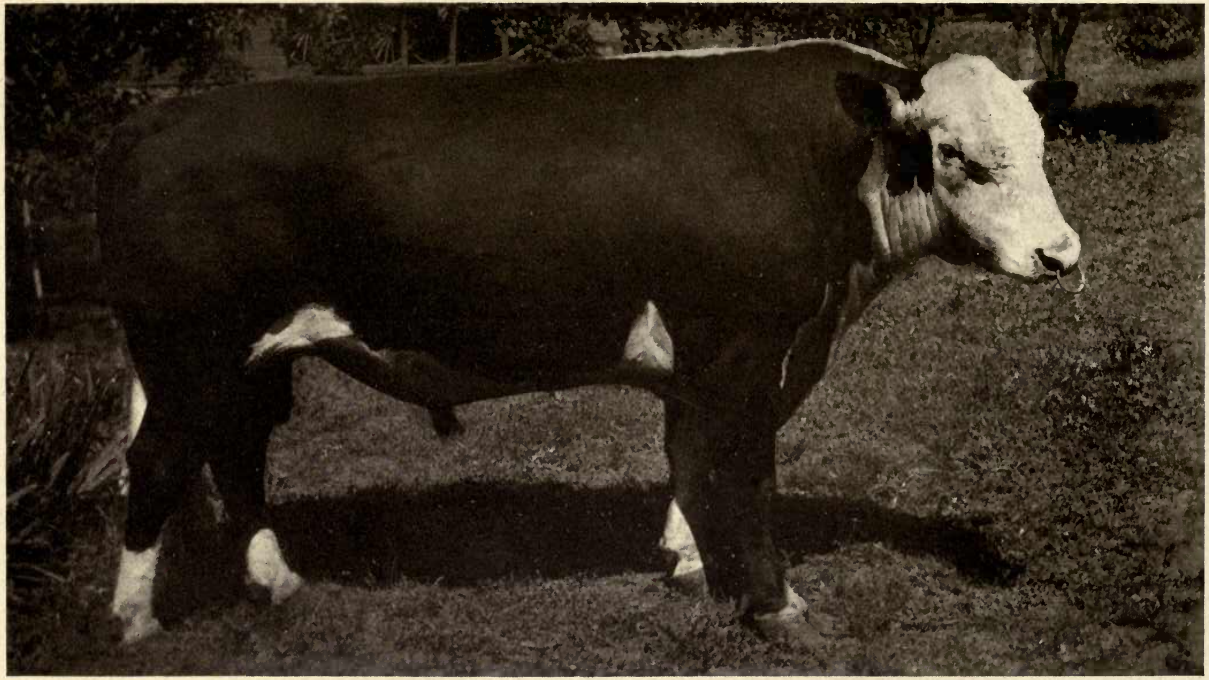
The prices paid on the market for beef animals of the various classes depend primarily on the quality of the animal and market finish, and secondarily on its size, appearance and conformation. The standard for the market classes of beef animals is obviously on a rather different basis than that of horses. Nevertheless, it is of prime importance for the beef raiser to make himself thoroughly acquainted with the market requirements for the different classes of beef animals in order that he may take measures to produce the best possible quality of animal, and be able to estimate the value

of different crops very closely so as to put his feeding upon a business basis.

FEEDING FOR BEEF

As already stated, farmers have devoted an unusual amount of attention during recent years to improved systems of feeding beef animals so as to meet the market requirements in this regard. It has become generally recognized as necessary to study all questions relating to the digestibility and effectiveness of feeds, early maturing properties of different breeds of cattle, and other matters relating to the increase in weight of cattle and the profits to be derived. In other words, sharp competition between the eastern and western states, and the advanced prices of all feeding stuffs and work connected with beef production have made it essential that each man watch carefully every point where any advantage may be gained and where a leakage in the profits may be stopped. Otherwise there is no use in attempting to produce beef since nothing but failure can be expected if the best equipment and the most skillful methods of applying all known agencies in the production of beef are not used.

In order to obtain a beef animal of the right form and quality it is necessary to start with the calf. Great changes have taken place in the last few years in the methods of feeding calves and at present several systems prevail. On the range each calf is allowed to suck its own mother until weaning time and the only other feeds which it gets during this time are the range grasses. On inclosed farms a number of methods have been adopted. The calf may be allowed to run with



Photograph furnished by W. W. Guthrie.

POLLED HEREFORD BULL.

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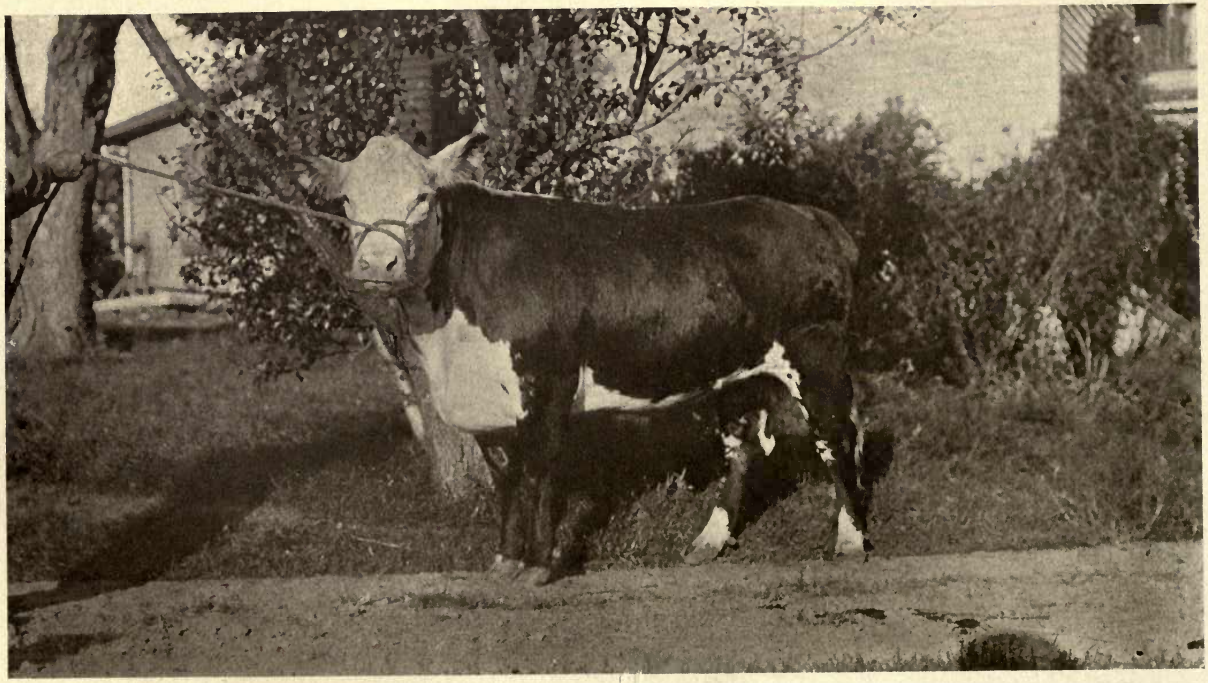

Photograph furnished by W. W. Guthrie.

POLLED HEREFORD COW.

its mother and take all her milk in case the farm is not conveniently situated for the disposal of the milk as such. The calf may also be confined and allowed to suck three or four times a day, being given suitable grain as an additional ration as soon as it is old enough to eat. According to this system two or three calves may suck the same cow at first, or, as the capacity of the calf increases, he may take the milk of two cows. Wherever there is a good opportunity of selling the milk or of making butter or cheese from it the question at once arises whether it is not possible to make more from the fat of the milk in butter and to give the calf substitutes for this fat in the form of grain.

According to this system, which prevails extensively throughout the dairy region, it is possible to combine dairying and the production of fine beef in the most economic manner. The milk is skimmed by a hand or machine separator, the fat sold as cream or in the form of butter and the fresh warm skim milk fed to the calves. If the purpose of the farmer is to raise baby beef, or bring his animals to maturity as soon as possible, it is somewhat of an advantage to have the calves come in the fall. They may then be maintained on skim milk and grain, with small amounts of roughage added, until spring when the grass starts. They are then turned upon pasture and thus suffer only a small check in their growth. At any rate, this check in development is less than takes place when the calf has been used to milk and grass during the summer and has to be weaned and changed to dry feeds in the winter. In general, however, where no special attempt is made to produce baby beef, the spring season is chosen by four-fifths or more of the cattle raisers as the time for their

calves to come. Statistics collected on this matter in Illinois indicate that about half of the feeders raise baby beef. Many of these men, however, include in the term animals of somewhat greater age than is usually allowed for this class on the market. As the result of extensive and repeated experiments in various parts of this country and in the provinces of Canada it has been demonstrated beyond question that the cheapest method of raising calves consists in allowing them to suck the cow for two to five days, after which they are gradually accustomed to skim milk, with the addition of grain feeds as soon as they are able to eat. The change from whole to skim milk must be accomplished with some care. After the calves are taken away from the cows, they should be kept where they cannot see the mother nor hear her too much, as otherwise they may be inclined to worry. At first the calves are taught to drink whole milk. This may be accomplished by the use of the finger or by artificial feeders of which several are on the market. After they are taught to drink, the whole milk is gradually replaced little by little with warm fresh skim milk during a period of three to five weeks. At the end of this time the calves receive nothing but skim milk. This must always be fed sweet and warm ranging in temperature from ninety-six to one hundred degrees F. The preliminary period of sucking the cow and drinking whole milk should be about two weeks and the period of changing from whole milk to skim milk another two weeks. The skim milk ration may begin at eight to ten pounds per day and should be gradually increased to fifteen to eighteen pounds at the age of four weeks after which it may be further increased, according to

SHORTHORN COWS AND CALVES.

Courtesy of Virginia Polytechnic Institute.

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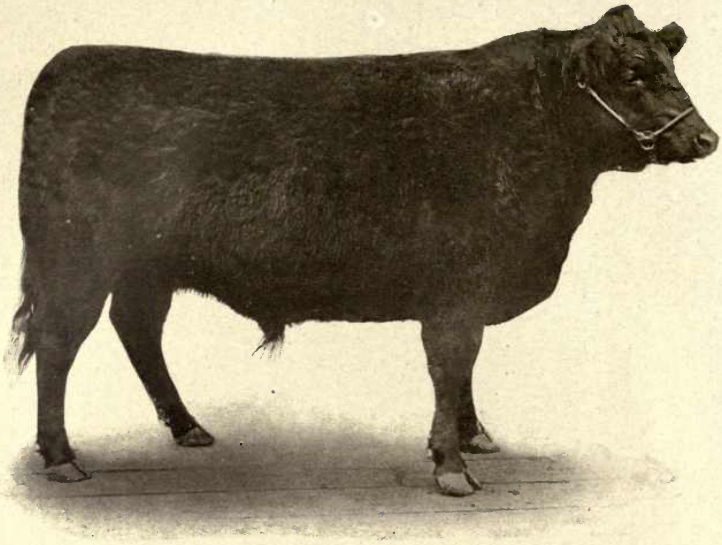
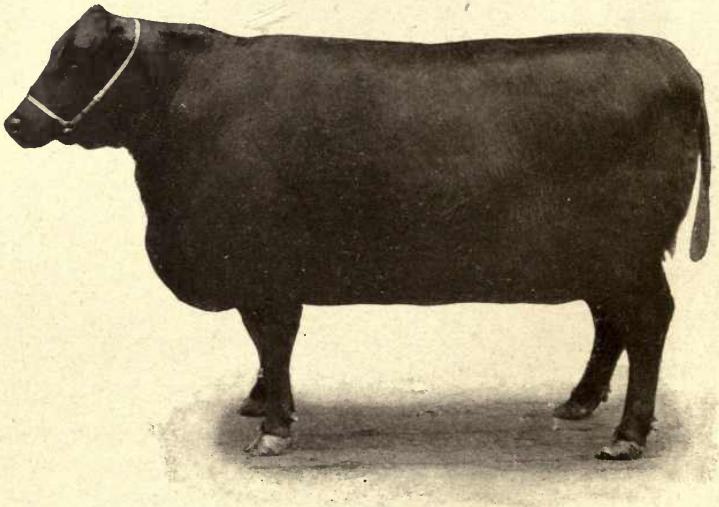


BLACK ROCK.

The Grand Champion Steer at the International Live Stock Show at Chicago.
A grade Angus fed and exhibited by the Iowa State College.



GLENFOIL ROSE.

Champion Two-Year-Old Angus Heifer at Kansas City and Chicago.
Small udder development, but of great beef capacity.

the size and capacity of the calf. It is absolutely necessary that attention be given to the milk during all this time to prevent it from becoming unclean or sour in the slightest degree, since, otherwise, scouring may take place and the calf will be considerably checked in its growth. In order to prevent the slightest scouring taking place, considerable benefit has been found in the use of lime water, rye bran or wheat bran each of which has a somewhat constipating effect. In order to obtain the best possible growth in calves, it is desirable to give them a liberal milk ration until they reach the age of five months. The milk feeding may then be stopped and the grain and forage ration increased.

It is desirable from the age of two or three weeks that calves be taught to eat grain. They may be taught to eat ground grain or meal by placing a small handful in their mouth, beginning at the age of two weeks. They soon learn to eat the grain and look forward to this portion of the ration with considerable relish. A large variety of substances have been fed to calves as substitutes for cream. The actual materials selected in each case will depend upon the relative prices of these grains or other feeding stuffs, and the convenience with which they may be obtained. It has been found that young calves will make a gain of three pounds per day on a ration of fourteen quarts of milk to which six eggs are added. Cod liver oil has been extensively used as a cream substitute, two ounces being added to each three gallons of milk. Cod liver oil is easily fed and is relished by calves and, under ordinary conditions, produces a rapid gain at a reasonable cost. In Ireland it has been found that calves may be raised more cheaply on skim milk, corn meal, and cod

liver oil, or some other cream substitute, than on whole milk. In one test the cheapest gain was made on skim milk and cod liver oil, a pound of gain costing eight cents on whole milk and three and one-half cents on skim milk, corn meal, and cod liver oil under the same conditions. Occasionally it has been observed that the greatest gains are made on whole milk, but almost uniformly it has been found that the use of skim milk and cream substitute gives excellent results at a great saving in the cost of the ration. Various other substances have been added to skim milk to take the place of cream, removed in separating. Thus, for example, starch, oleomargarine, scalded linseed meal, corn meal, Kafir corn meal, rice meal, cocoanut oil cake, cocoa shell milk, hay tea and other materials have been used with more or less success. In substituting a material in the calf ration for the cream, attention must be given to the cleanliness of the grain or other materials used as otherwise the calves may scour. In this regard, cod liver oil has been found very beneficial as it apparently obviates the danger of scouring and in one or two instances has given better results than a mixture of linseed meal and molasses, which in turn were more expensive than the cod liver oil. In some cases cod liver oil has been added to the ration in the proportion of two ounces to five quarts of milk, after the calves had been fed on whole milk for a period of five weeks. It is usually best, however, to make the change from whole milk to skim milk and cream substitute at an early age. Cocoanut oil cake has been used with success at the rate of four ounces to three gallons of milk, with the further addition of two ounces of molasses. This mixture, however, is not as easy to

prepare as many other similar ones. Cocoa shell milk may be prepared by boiling one-quarter of a pound of cocoa shells in two gallons of water and feeding the milk thus produced in rations of one and one-half to two gallons daily.

A large number of feeders have had the best results from the use of flaxseed meal as a substitute for cream. When this cannot be obtained in suitable quantities corn meal and Kafir corn meal or other similar grain mixtures may be used in its place. Corn oil has been found rather too laxative to use in calf feeding, even when added to the milk so as to make a two per cent. mixture. Linseed meal gives uniformly good results. It is not only an excellent food for replacing the cream for calf feeding, but is also a very economic food. It may also be mixed with germ oil meal with good results.

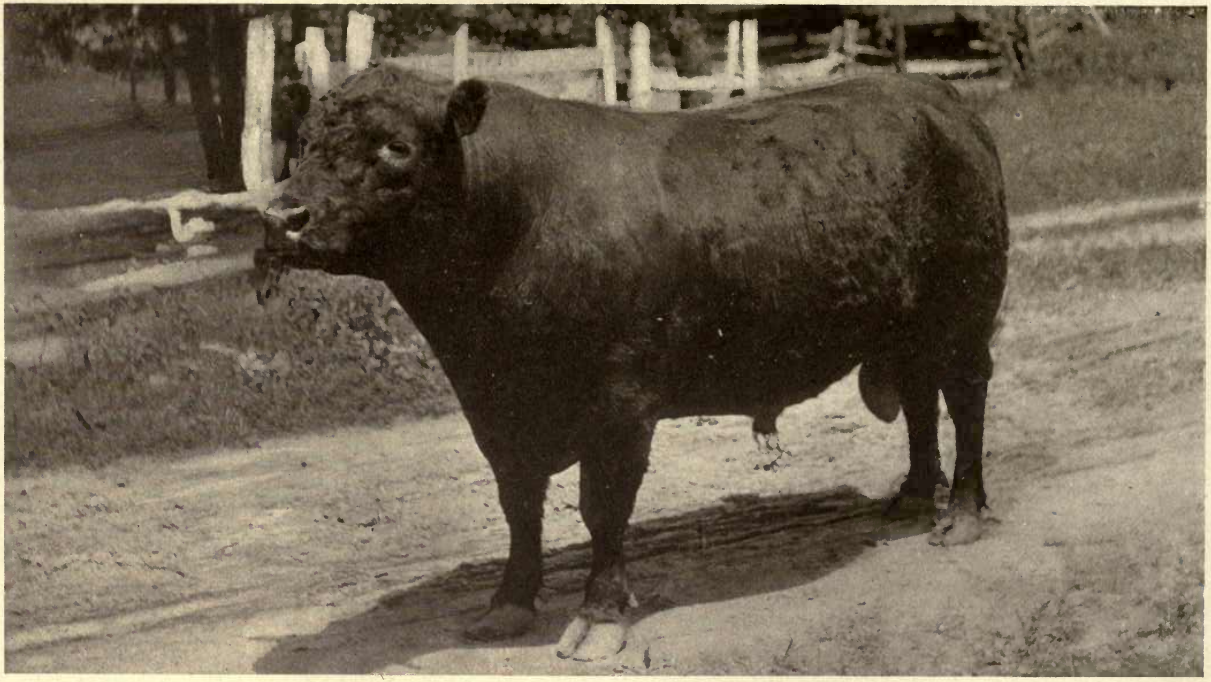
In Pennsylvania it was found possible, as the result of numerous experiments, to raise calves of prime quality without any milk whatever after the age of two weeks. A number of successful milk substitutes were devised. One of these contained a mixture of sixteen and two-thirds parts flour, thirty-three and one-third parts flaxseed meal and fifty parts linseed meal. Another contained wheat flour, cocoanut meal, nutrium, linseed meal, and dried blood in the proportion of 30:25:20:10:2. Still another contained corn meal, nutrium, flax seed, dried blood, flour, cocoanut meal and oat chops.

In Kansas considerable experience was had with the use of calf-feeders, consisting of a rubber tube fastened at a convenient height for the calf to reach, and the tube being connected with the milk in the pail. Considerable difficulty was had with the man-

agement of the calves by this method and, in general, it is believed that it is easier to teach the calf to drink with the fingers. In the Kansas experiments the best results were obtained from feeding the calf three times a day,—four pounds in the morning, two at noon, and four again at night. After about two weeks the feeding periods need not be oftener than twice daily. During the first few days, however, the calf may well be fed five or six times. The amount of skim milk to be fed as soon as the whole milk is discontinued must be determined by the appetite of the calf. All experiments, however, agree in the point that the milk must always be sweet.

The cost of raising the calf up to the time when it can be put on a grain and hay ration at about four months of age was found to be $10 in Pennsylvania. In Connecticut it cost from $11.50 to $12.90 to raise calves to the age of six months and in New Hampshire the total cost of raising calves to the age of seventeen weeks was $9. In Connecticut the cost of raising calves from birth to a proper market condition at the age of two years, according to the methods just outlined, was found to be $33 per head.

Baby Beef.—It is assumed in forcing calves, in the manner just described, that they are being raised for the purpose of producing baby beef. The economy of bringing a considerable percentage of calves to a market condition at the age of one to two years should be apparent from the following discussion. In the first place, heifers at this age bring as much pound for pound as steers and this is the only period of life when such a condition is true. It is obvious that with a shorter feeding period less expense must be incurred in caring



GALLOWAY BULL—FURNISHES FINE MEAT AND BEAUTIFUL ROBES.

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GALLOWAY HEIFER—A HARDY ANIMAL GAINING IN FAVOUR.

for the animals and less material required for maintenance and fattening. In Kansas it has been found that after the period of calfhood, above described, has been passed, alfalfa hay and corn, or Kafir corn, will put steers and heifers in excellent market condition at two years of age. In many tests of skim-milk-fed and sucking calves, it has been found that the early training which skim-milk calves receive in the way of constant handling and in learning to eat and drink stand them in good stead during the fattening period, so that the total gains made by such calves are greater than those made by sucking calves, while the food required per pound of gain is somewhat less. In the production of baby beef it is necessary that the feed be fresh and palatable at every feeding period and that the animals should be handled in such a manner as to induce them to eat all that they can with safety. The best results are usually obtained by feeding corn mixed with chopped roughage (alfalfa hay or a similar material), since, in this way the ration appears to be rendered most palatable and animals are less likely to get off their feed.

The production of baby beef is a specialty which requires great skill in feeding and should not be undertaken on a large scale until some preliminary experience has been had in a small way. The kind of cattle to be used for this work cannot be prescribed rigidly for all sections. Of course, no scrubs can be used, in fact, nothing but pure beef breeds or good grades of these breeds. They all mature fully at the age of 30 months and can be put in a fine marketable condition as baby beef at the age of two years. The champions of the various breeds claim that each is the best, but no one will make a serious mistake by selecting any one of the three.

The importance of raising baby beef has been well stated by the Kansas Experiment Station. The farmer who raises and fattens for the market mature steers has to provide sufficient pasture for his cows and his steers for three years. During this time he can realize nothing on his animals, and only one-fourth of his total herd are cows producing calves. Where, however, the farmer raises baby beef he can stock his farm to the full extent with cows and may obtain returns from his steers and heifers which he has fed for the market within one year. Thus, his capital is turned over three times as fast as by the other method and a correspondingly greater profit is made.

FEEDING FOR MATURE BEEF

In feeding steers so as to bring them to a marketable condition at the age of two and one-half years or somewhat later a large variety of feeding stuffs is at the disposal of the feeder. If his animals have been properly fed during their early life by the use of a balanced ration containing a suitable amount of nitrogenous material, the animals at the beginning of the final feeding period have a sufficient strength of bone and digestive power to enable them to be forced rapidly by the use of cheaper, more carbonaceous foods. The scheme of economic beef production, therefore, consists in the use of sufficient nitrogenous feeds for young animals to give them proper development and constitution to endure forced feeding just before they become mature.

Corn is the king of all grains which may be used for the production of beef, pork or mutton. It has been found by carefully conducted experiments

and by the experience of innumerable farmers that beef can be excellently fattened without the use of any other grain than corn. Such a statement cannot be made of any other known grain. The problem of the feeding of beef cattle, therefore, consists largely in determining the form in which corn shall be fed, the amount to be fed and the amounts of other grains which may be economically added for the purpose of increasing the appetite of the steers or for arranging the ration more economically at times when corn is extremely high. During the early fall, in some parts of the country, the frost may injure the corn so that it does not properly mature. The question, therefore, arises regarding the nutritive value of such corn as compared with hard fully-matured corn. Careful experiments have shown that such soft corn is fully equal in feeding value to mature hard corn. Cattle make about as good gains and show about as fine a finish as on the mature corn. When corn injured by frost can be purchased for thirty cents per bushel and mature corn for fifty cents, the production of beef is possible at a cost of three and one-half cents less with soft than with hard corn. Apparently, the amount of moisture present is the only point in which soft corn differs from mature corn in so far as feeding is concerned. While corn, as already indicated, is considered to be the king of all grains for the fattening of steers, the use of other grains such as linseed meal, cotton seed meal or gluten meal shows an increased rate of gain and a slightly finer finish in the majority of cases than does corn used alone. These feeds are especially valuable in balancing the ration when the roughage used does not contain much nitrogen. The extent to which such feeds are to be used will

depend entirely upon the relative price of corn and the nitrogenous feeds in question. Experiments, indicating the value of supplemental feeds with corn have been carried out at the Iowa and Nebraska Experiment Stations and elsewhere.

A study of cattle farms in Illinois showed that in feeding steers in the winter about twenty-five per cent. of the farmers used shocked corn, thirty-nine per cent. ear corn, ten per cent. shelled corn, three per cent. corn and cob meal. In summer feeding about three per cent. used shocked corn, fifty per cent. ear corn, thirty-six per cent. shelled corn and five per cent. corn meal. A most careful study of the methods of feeding corn has been carried out at the Illinois Experiment Station. It appears from these tests that the value of steers per hundredweight may vary as much as fifty cents, depending on the method under which they were fattened, and that this amount is often sufficient to make a difference between actual profit and loss to the feeder. According to these experiments corn and cob meal does not appear to be so valuable for fattening steers as corn meal. Ear corn, however, is much more efficient for the production of beef than is shelled corn, and experiments along this line show this point so conclusively that we must decide against the grinding or shelling of corn for feeding steers, at least during the winter season. It obviously does not pay to grind corn during the winter, but during the summer, while the steers are on grass, the conditions may be somewhat different.

As already indicated corn is so necessary from a financial standpoint in fattening steers that a center of corn production is practically synonymous with one of beef production. In general,

it will be observed that the area where the best beef is grown is co-extensive with the corn belt. Statistics show that the eleven chief corn states, which produce seventy-five per cent. of the corn crop of the United States, produce also sixty per cent. of the fine cattle, milch cows, sheep, hogs, horses and mules. The importance of corn is even greater than would appear from this statement, since thousands of range cattle and sheep are annually shipped into the corn belt for fattening. Corn affords not only ear and shelled corn, corn stover and silage, all of which are most excellent for the production of beef, but affords also a large variety of milling products including corn meal, corn and cob meal, hominy chop, corn bran, corn germ, corn-germ meal, various kinds of gluten meal, gluten feeds, starch feed, etc. From this list of feeds it is apparent that a selection may be made among the many gluten meals and gluten feeds so as to balance the ration with corn meal or shelled corn. This is possible because of the protein in corn remaining in the gluten meals and gluten feeds after the starch has been removed in the process of manufacture.

Corn is thus conceded by all investigators to be the best exclusive grain ration for fattening animals of all kinds, considered both from the standpoint of efficiency and economy. The best methods of increasing the already great effectiveness of corn consist in supplementing corn with some nitrogenous grain or forage. This may be done most cheaply by the use of clover hay, alfalfa hay, or cowpea hay in the East, West and South respectively. By means of this combination of corn with nitrogenous hays a most effective ration is obtained and beef is produced at the lowest psosible cost.

Cotton Seed Meal.—This meal is known to be one of the most nitrogenous of all grain foods and, therefore, furnishes a satisfactory means for balancing the corn or other carbonaceous grains in rations for steers as well as for other animals. In Illinois it appears that cotton seed meal is fed by about seven per cent. of the beef raisers in rations of from one to nine pounds with an average of four pounds per day. This may be taken as an average use of cotton seed meal for the northern states. In the cotton belt the meal is used much more extensively on account of the effectiveness of cotton seed meal and on account of its great economy, both as a direct beef producer and as a means of balancing the ration. In Iowa it has been found that by means of corn and cotton seed meal in rations of average size steers may be made to gain two and one-third pounds per day. Steers fed on shelled corn, cotton seed meal and sorghum hay in Mississippi dressed fifty-nine per cent. of the live weight and showed a relatively low shrinkage on shipping to market. As a result of quite extensive experiments with cotton seed meal in Oklahoma, it is recommended that not more than eight pounds per day be fed to steers, and as a rule better results are obtained from four to six pounds. Contrary to what might be expected from theoretical considerations it appears that the best results are obtained with cotton seed meal when the coarse forage is highly nitrogenous, for example, alfalfa and cowpea hay. Cotton seed meal mixed with a carbonaceous grain such as Kafir corn, or corn with more nitrogenous grains, such as wheat or barley, adds palatability to these grains and induces the steers to chew them more thoroughly. In one set of experiments good gains were produced from

steers on a ration of eleven and one-half pounds wheat meal, three and one-half pounds cotton seed meal and four pounds of prairie hay per day. When corn costs as much as or even a little more than cotton seed meal, it is profitable to use it in replacing a portion of the cotton seed meal. In feeding experiments carried on in England, cotton seed meal showed a lower feeding value than decorticated cotton seed cake. In a series of tests in Alabama it was found that when sorghum was used with the cotton seed meal steers showed a better percentage of dressed beef than when sorghum was replaced with mixed hay or corn stover. In the rapidity of gain, the cotton seed meal and sorghum ration also stood at the head and, likewise, the amount of food required for a pound of gain was less with this ration than with any other.

Distiller's Grains.—Recently the by-products of distillation have been tested to a limited extent in feeding cattle, pigs, horses and other animals. It appears that dried distiller's grains in combination with corn are a very economic ration for steers.

In a set of experiments in Kentucky this ration proved the cheapest and less corn was required for a pound of gain, when distiller's grains were used quite extensively.

Gluten Feed, as well as gluten meal, has proved a very effective grain for domestic animals. In fattening steers, gluten feed in some experiments has proved superior to a mixture of cotton seed meal and ground wheat. The daily ration may be five or six pounds. Gluten feed is not expensive as compared with its feeding value and often gives a greater profit than a mixture of cotton seed meal, barley and linseed meal. Certain feeders have found it advisable to begin the feeding of gluten

meal at the rate of one-fifth pound per day, increasing gradually to four pounds as a maximum. In Iowa steers on a ration of corn, gluten feed and wheat straw gained two and nine-tenths pounds per day at a cost of $9.65 per 100 pounds of gain. In England gluten feed has been found to compare well with oats, mixed grains, cotton seed meal, linseed meal and other mixed grains.

Linseed meal enters into the fattening and growing rations of nearly all farm animals. It has been found in Scotland to give better gains than corn or a mixture of cotton seed meal and linseed meal. In feeding this meal, Scotch beef producers have found that it is best to make the ration narrower as the feeding period progresses. This is accomplished by adding relatively larger quantities of linseed meal. In Iowa linseed meal has been fed with great profit by gradually increasing the ration from one-fifth to four pounds, in addition to nineteen pounds of corn daily. In Illinois, inquiries among many farmers elicited the information that linseed meal is fed in rations of from two-tenths to six pounds daily by the beef producers of the state. All of these highly nitrogenous products such as gluten meal, linseed meal, cotton seed meal, etc., have the additional advantage that they improve the appearance of the coat and thus give the steers a better market finish.

Oats.—This grain is usually too expensive to constitute the whole ration for any of our domestic animals. It is quite largely fed, however, in certain states to steers and with good results. Oats enter into the ration fed by some of the most extensive cattle feeding companies in Nebraska, and are considered very valuable for the purpose. In Montana a ration of mixed corn and wheat alone

was found to be considerably superior to oats. Oats, however, were equal to barley. Steers did not as easily become tired of oats in the ration as is the case with wheat. Many feeders use oats in the sheaf in feeding steers and in some cases their value has proved to be about equal to that of wild rye grass for this purpose. In Texas a test of oats for fattening steers showed that they possessed about the same value as grain chops.

Peas are quite generally used in England, Canada and the United States in a whole or ground condition, preferably the latter. In Canada it has been found that pea meal causes more rapid gains than corn, but on account of its expense is not so economic. Peas and oats together are found in a large percentage of the mixed grain rations fed to steers in Canada.

Rice Products.—The recent development of the rice industry in Texas has led to experiments for the purpose of testing the value of rice products in feeding stock. It has been found that the use of rice hulls in large quantities is attended with some danger. The hulls contain sharp pointed fibers which may produce irritation of the mouth and stomach. Such trouble occurs, however, only when rice hulls are fed in large quantities. They have a feeding value practically the same as wheat straw. Rice polish is slightly superior to corn in feeding value and resembles wheat or oats in this respect. In addition to these two forms of rice products, rice bran is used in three qualities, pure, mixed with rice hulls and mixed with rice polish and hulls. The mixture of rice bran, polish and hulls in the proportion in which they come from the whole grain has a considerably higher feeding value than the rice bran.

Rye is not an important feed in fattening steers, partly on account of the limited extent to which it is grown and partly for the reason that it is not so palatable as other grains. In Idaho fairly satisfactory results were obtained in steers when fed a grain ration consisting of one part chopped rye, one part bran and two parts chopped wheat. The chopped rye, however, was not very well relished by the steers.

Soy-Bean Meal.—This is used in increasing quantities in parts of the South. Along with other similar legumes it has the advantage of improving the soil and on this account has received more attention of late years in the South. In Kansas soy-bean meal was scattered over the other grains in the feeding boxes to the extent of one-half pound per head at first and this amount was gradually increased to a maximum of four pounds per day. The meal when fed in rations of this size proved to be too laxative and had to be reduced to one pound. On account of its pronounced laxative effect the use of soy-bean meal was discontinued as a part of the steer ration in Kansas.

Velvet Beans.—Velvet beans in the pod have been fed in Florida in rations of three bushels. When fed alone with a suitable roughage it appeared to constitute a ration which was somewhat inferior to a nitrogenous hay and cassava.

Wheat when chopped and fed as the only grain ration, in combination with corn silage and hay, is a very effective ration in fattening steers. It appears to be somewhat superior in this respect to barley or oats. When wheat is fed continuously, steers tire of the ration after a period of two months and a change is necessary to induce them to eat a maximum grain ration. In England when wheat

was compared with corn it was found that corn meal made more rapid gains and at less cost than wheat. The rapidity of gain in steers fed wheat in Nebraska was greater than that of those on an exclusive corn ration. During a short feeding period steers on wheat gained twenty-two pounds per head more than those on corn.

LIGHT, MEDIUM AND HEAVY GRAIN RATIONS COMPARED

A practical question of great importance to the ordinary feeder is how much grain can be fed with the best results. This question has been thoroughly studied at a number of experiment stations and the results obtained were fairly uniform and satisfactory. In a series of experiments rations of sixteen, twenty and twenty-four pounds of corn were compared with reference to their effectiveness and economy. It was found that the steers which received the small corn ration did not show the same thickness of flesh and finish possessed by the other lots. In general, it appears that gains in fattening cattle may be made at a smaller cost with light or medium rations than with heavy ones. In a feeding period of 190 days, however, it is often impossible to put a sufficiently fine finish on cattle maintained on a light or medium ration. The difference in the selling price of finely finished cattle is usually more than enough to compensate for the cheaper gains made by the smaller rations of grain. On this account the use of heavy grain rations is most profitable to the feeder. The size of the grain ration is indicated in the above discussion in connection with each particular grain and in general must be determined by the appetite

of the steers. The grain ration may be made as large as the steers will eat clean and with appetite. In Montana it was found that on a ration of nineteen pounds of clover hay per day, more economic gains were obtained when barley was fed in five-pound rations than when fed to the extent of nine pounds. It is calculated, therefore, that the maximum rate of gain is to be secured from barley fed at the rate of one-half pound per hundred pounds live-weight of steers. While it is generally true that the extra gains obtained from heavy grain rations put a finer finish on steers than can be obtained by light grain rations, nevertheless, this is not always the case, and if care is not exercised the extra gains thus obtained may fail to compensate for the extra cost of the ration. When the grain is fed separate from the roughage the steers are likely to chew it too little and swallow it quickly. It may be, therefore, that a considerable portion passes through the alimentary tract undigested. When the grain is mixed with the roughage it has been found that the steers spend some time in chewing the whole ration and, therefore, swallow the grain in a finely cracked condition and exposed to the rapid action of the digestive juices. Some feeders believe, therefore, that the best results are obtained when the feed is so mixed that every mouthful which the steer takes contains some grain and some roughage.

The amount of grain which is shattered off in harvesting cereals makes it worth while to graze old stubble fields. A test of the feeding value of shattered grain was made in Montana with the result that the stubble fields were found to be worth $1.50 per acre above the maintenance ration of steers, pigs, and other animals grazed on such fields.

Courtesy of Division of Publications, U. S. Department of Agriculture.

HERD OF HIGHLAND CATTLE — THE SMALLEST AND HARDIEST OF BEEF BREEDS.

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BEEF STEERS, FEEDING BARN, AND YARDS IN CANADA—CLEAN, DRY AND CONVENIENT.

PROPRIETARY FEEDS

An almost innumerable list of proprietary and condimental feeds has been compounded and placed upon the market with advertisements regarding their virtues. Some of them are claimed to increase the palatability of all feeding stuffs, to induce a more rapid growth than can otherwise be obtained, prevent indigestion, cure various diseases, and offer insurance against other losses. Obviously such claims are quite impossible of fulfilment. As a rule, the proprietary and condimental foods advertised on account of their medicinal properties contain well known drugs such as aniseed, fenugreek, coriander, etc., which may be purchased much more cheaply than the price asked for them in condimental foods. In Scotland tests were made of condimental foods, which were found to be considerably inferior to oats pound for pound for cattle. Some benefit was derived, however, in a long series of experiments by adding to the ration two ounces of a mixture of equal parts of fenugreek, caraway, coriander, and aniseed. If cattle are cared for in the proper manner and kept in sanitary conditions, groomed and fed a well-balanced ration, with variations from time to time, the health and appetite of the animal should remain unaffected during the ordinary feeding period of 150 to 190 days.

ROUGHAGE FOR BEEF PRODUCTION

Alfalfa.—This is at the present time the most important and the most effective roughage for beef production. It occupies the same position in the list of forage plants for steers which corn does in the grains. It may be fed green or in the form of

hay, whole or cut into short lengths. In Kansas it cost about thirty cents per ton for the labor to cut alfalfa hay into one-inch lengths. Steers on cut hay were found to gain about seven pounds per head more than on whole hay during a feeding period of usual length. It is obvious, therefore, that if the feeder is properly prepared to cut alfalfa hay, it will pay to run it through a feed cutter for steers. As already hinted, a combination of alfalfa and corn makes an ideally balanced ration for steers and is exceedingly economic and effective. The unusual value of a combination of alfalfa hay and corn for the production of fine beef has been demonstrated by numerous experiments and by the practical experience of beef raisers throughout the country. The flavor of the beef produced by alfalfa hay and corn is excellent. In feeding alfalfa hay worth from $5 to $7 per ton on the market in New Mexico from $10 to $13 per ton was obtained by turning it into beef. The economy of marketing it in the form of beef is, therefore, obvious. For beef production it is recommended that alfalfa hay be stacked in the field, since in this way more of the leaves are kept in connection with the stems than by other methods of handling. By feeding a combination of alfalfa with a succulent feed it is possible to make very rapid gains in steers and at the same time to put them in the best market condition. Corn stover or even corn silage does not contain the nutriment required by the steer for producing the best results in beef. When this forage material is supplemented with nitrogenous feed, such as alfalfa, linseed meal, or cotton seed meal, better results are secured. Alfalfa and silage, moreover, not only furnish a combination which yields excellent beef, but can

almost always be depended upon for the production of good health. In fact the effectiveness of alfalfa and its suitability for steer rations is apparent from a test made in Kansas in which twice as much profit was obtained from the use of alfalfa for roughage as from any of the other ordinary forage plants used for this purpose.

Brome grass hay is about equal to western rye grass for the production of beef. In Canada it has been found that cattle require less grain feed when fed brome grass hay in ordinary rations, but that there is more profit from corn stover than from brome grass.

Clover Hay.—This is generally considered excellent roughage for steers. It takes the place of alfalfa throughout that portion of the eastern states where alfalfa has not secured a commercial foothold. Like alfalfa, clover makes it possible to economize greatly in nitrogenous grain feeds when corn is used as the main grain ration. Clover like alfalfa may be fed ad libitum to steers without danger, provided the material is clean and properly cured.

Corn Stover.—Corn stalks are valuable as roughage for steers in all forms in which they have been prepared either as corn stover, stripped corn leaves, silage or shredded corn fodder. The relative loss of nutrition in corn stored in the form of silage and cured in the field differs very little, so that the method of storing may be determined by the special circumstances under which the farmer is situated. As a rule corn can be most economically stored and harvested in the form of silage. Generally one pound of corn fodder is equal to three or four pounds of silage. In Alabama shredded corn stover of a poor quality and some-

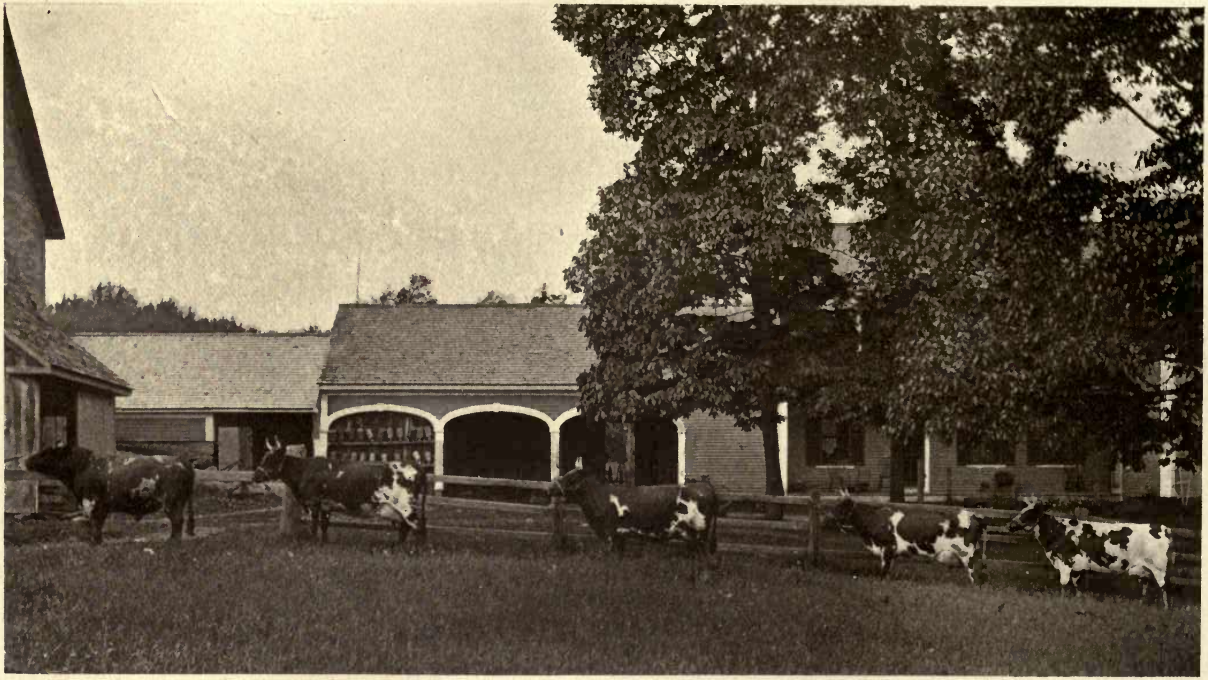
what unpalatable was found to be inferior to sorghum. This test, however, was not fair to the corn stover since thirty-seven per cent. of it remained uneaten. In Illinois it has been found that eighty per cent. of the beef raisers pasture corn stalks in the field or cut part of them for shocked corn and pasture the remainder. It is an astonishing fact that a considerable portion of the corn fodder found in the corn belt where fine steers are raised, is plowed under or burned. Its feeding value is much too high to be treated in this manner. When corn stover is compared with silage for both summer and winter feeding, it is found that shock corn produces slightly better gains than silage. The difference, however, is not of great consequence. As a rule corn silage is not fed extensively to steers. From statistics collected in Illinois, it appears that only eight feeders to whom circulars were sent mentioned the use of silage for feeding steers. It is, of course, fed throughout the same part of the country much more extensively and regularly to dairy cows. Some feeders, however, have obtained very satisfactory results in feeding silage. Steers take a fine market finish and show a good condition of health during all of the feeding period. A study of the relative profits from silage and shock corn in Illinois indicated that it required nearly twice as great an expenditure of labor and capital in harvesting and feeding silage as in feeding shock corn. During these same investigations, silage-fed steers appeared more thrifty and were in a better finish at the end of the test than were the steers which received shock corn. The amount of silage fed in these experiments ranged from fifteen to thirty pounds per head.

Cowpea Hay.—Cowpea hay when fed to steers with corn as the grain ration produced a gain of two and six-tenths pounds per head daily, while timothy and the same corn ration made a gain of one and six-tenths pounds, and corn fodder one and nine-tenths pounds. Both clover and cowpea hay give a better market finish and a finer coat to steers than timothy or corn fodder, with corn as the exclusive grain ration. This is due to the fact that leguminous hays balance the ration. It is evident that these hays should not be sold, but held on the farm and fed in the production of meat. In Tennessee, cowpea hay has been tested as a substitute for cotton seed meal, substituting two pounds of hay for one of meal. The results from this experiment were very satisfactory, a considerable increase in the gain being produced by the partial substitution of cowpea hay for cotton seed meal. When large crops of cowpea hay can be produced cheaply throughout the South it is obvious that this hay may be utilized to advantage in replacing a portion of the corn meal, cotton seed meal, or other portions of the grain ration which are more expensive. Cowpea hay cannot be so well substituted for cotton seed meal in the case where the ration is succulent as where the ration is dry.

Johnson Grass.—In the southern states cotton seed hulls are fed sometimes as the exclusive roughage to steers. A test was made for the purpose of comparing the feeding value of Johnson grass hay with these hulls. In this test it appeared that one pound of Johnson grass is equal to one and two-tenths pounds of cotton seed hulls for feeding purposes and is worth $10.00 per ton.

PASTURES

The pastures in which steers are allowed to run vary greatly in different parts of the country. In some localities they contain nothing but native grasses and are often not continuously sodded over. On the other hand in localities where a more intensive system of farming is practiced the pasture may always consist of some cultivated forage plant, especially leguminous or mixed grasses in fine condition. On the western ranges, pasture consists of the highly nutritious range grasses which cover the arid plains and which are as nutritious as well-cured hay in winter. Statistics collected in Illinois indicate that pastures contain blue grass in fifty-five per cent. of cases, timothy in twenty-five per cent. and clover in ten per cent. In many tests carried on at experiment stations, the use of pastures in fattening steers has not given satisfactory results. Nearly all practical feeders, however, give their steers the freedom of a pasture and find that the results are satisfactory both in the rate and economy of gain. In general, it is necessary that a small grain ration be fed to steers on pasture even if they are not being forced at the time. In Nebraska it has been found that when steers are to be marketed in the fall or early winter there is more profit in keeping them on pasture during the summer with a grain ration whereas, when steers are to be marketed in the spring there is more profit in keeping them on pasture without grain. In Alabama some interesting data were collected regarding the gains made on native pasture by scrub cattle. These observations extended over a period of three years, during which the native cattle were



AYRSHIRE HERD IN THRIFTY FARM SURROUNDINGS.

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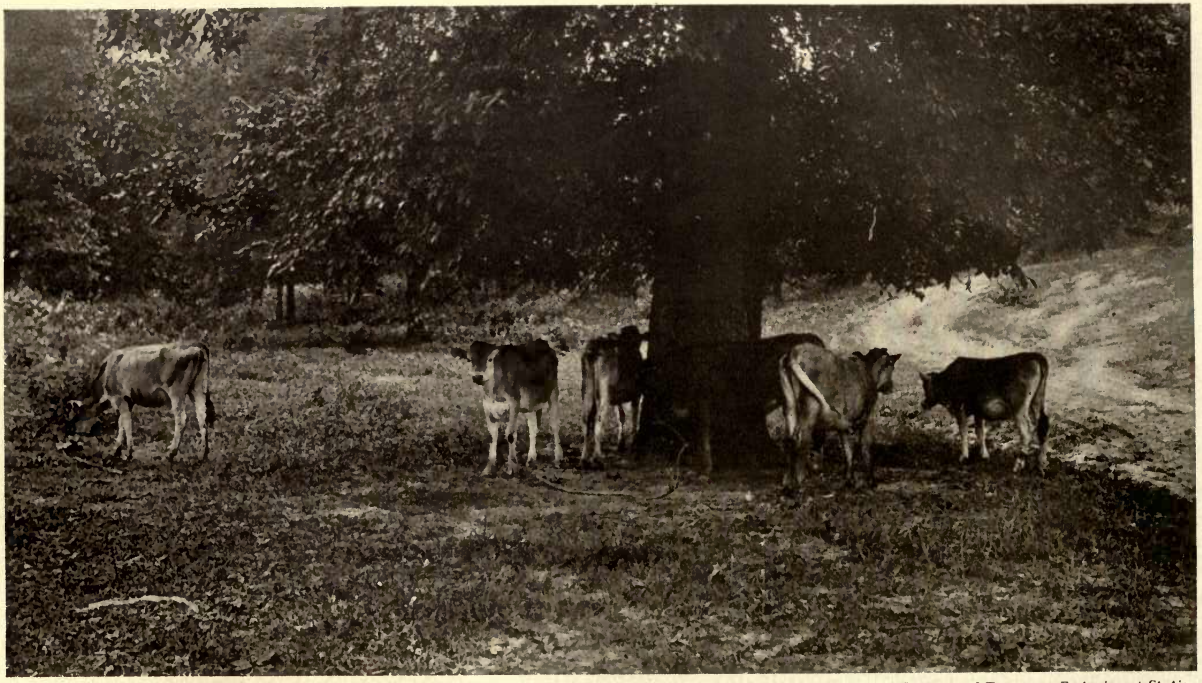


Courtesy of Tennessee Experiment Station.

PROTECTION FROM THE SUN — COWS NEED SHADE IN SUMMER.

allowed to graze on low fields and swampy thickets. The average daily gain was estimated to be .28 of a pound for cows, .49 for yearlings, .67 for sucking calves, .79 for steers and bulls and .82 for heifers. The total gain made by scrub cattle on native pasture during a period of seven months ranged from 103 to 172 pounds per head, or a beef value of $2.58 to $4.30. Cattle maintained in unimproved southern pastures throughout the winter, however, may lose weight greatly and in many instances as shown in Florida and elsewhere may become badly emaciated. In the use of pastures for beef animals it is highly desirable to prevent their being overstocked. If the grass is to have the full value which it should have in the ration it is necessary that it be present in suitable quantities and be easy of access for cattle, otherwise they do not obtain as much as is needful and lose time in hunting for it.

Numerous other coarse feeds are used more or less extensively throughout different parts of the country in rations for steers. Thus Pearl millet has been tested in a number of localities with rather unsatisfactory results. Steers did not do as well on it as on Kafir corn or corn stover. On the western ranges, considerable feeding value has been found in the prickly pear. This cactus may be fed in rations of forty to two hundred pounds. It has been found that oxen may be worked on an exclusive ration of prickly pear and, when fed in this way, need water only two or three times a week. Hair balls may form in the stomach, however, from an excessive use of this feed. Prickly pear may be rendered edible by singeing the spines off, slicing, steaming or ensiling. Rye pasture has been used as a part

of the ration for fattening steers. In Alabama it was found that steers gain at the rate of one and sixty-seven hundredths pounds per day on this pasture. Green rye, however, is not suitable for an exclusive feed, but should be supplemented with liberal grain rations. It appears that sorghum silage can be produced at the rate of seven tons per acre or slightly less than the average yield of corn made into silage. The cost of raising and harvesting an acre of sorghum is $13.00. Silage made from sorghum is a very satisfactory roughage for cattle and seldom causes any trouble except in rare instances where the second crop develops hydrocyanic acid. Soybean silage in a ration of twenty-five to thirty pounds daily is an excellent feed for wintering calves with an additional grain ration of one to two pounds cotton seed meal and five pounds corn. Speltz straw is useful in fattening steers and may be considered as worth about half as much as ordinary hay.

Investigations instituted in Illinois developed the fact that the cattle raisers of that state use clover hay most as a roughage for steers, followed by corn fodder, hay, oat straw, corn stover and blue grass hay. A few of the beef raisers of the state use cowpea, alfalfa, redtop, sorghum, millet hay, sheaf oats and silage. Similar variations prevail in other states in regard to the roughage. In Canada tests were made of cut and uncut hay for the purpose of determining its relative feeding value. In this experiment it was found that the cost of one hundred pounds of gain on a ration containing cut hay and cut roots was $10.80 and on a ration of uncut hay and roots $11.50. The economy of the process will

obviously depend on the expense of cutting.

Some form of succulence is quite necessary in order to obtain the best results from the other parts of the ration. Roots may be fed in rations of twenty-five to sixty pounds per day. In England it has been found that a ration of fifty-six pounds of swedes per day is effective and cheaper than when one-half of this root ration is replaced by clover hay, molasses and corn meal. It is recommended by English feeders that fattening steers should be fed at least twenty-eight pounds of roots per day. The feeding value of different roots for steers is very similar.

In Florida cassava has been fed to steers, partly for succulence and partly to supply the starch part of the ration. The benefits derived from cassava were very striking in certain cases. Cassava was given in rations of thirty pounds, or cassava pulp, from starch factories, in rations of eighteen pounds mixed with five pounds of cotton seed meal. Cassava pulp is sold at a price which renders it less economic than the whole root. Rarely, cassava may contain prussic acid. Certain Queensland feeders, therefore, recommend that cassava should be sliced and boiled before feeding.

Sugar beet pulp has lately become one of the most important feeds for adding succulence and increasing the digestibility of the ration for steers. It is sold from sugar beet factories at from fifty cents to $2.50 per ton and at this price is an economical feed. It is not only bought and fed on a small scale by farmers, but has been used in enormous quantities by a number of the extensive cattle feeders of the West. Sugar beet pulp contains essentially the same elements as sugar

beets with most of the sugar removed. No precautions are necessary in feeding it, provided it is clean when received. In Wyoming it has been fed in rations of fourteen pounds with alfalfa hay, while in France rations of sugar beet pulp as high as one hundred and twenty-six pounds daily have been used. Reports thus far received from farmers and feeders are quite favorable to an extensive use of sugar beet pulp and, as already indicated, it is becoming a more and more important feed. The Colorado Experiment Station advises absolute cleanliness in handling and feeding it, and calls attention to the fact that it may readily freeze in winter and, therefore, become uneatable. Apparently, cattle prefer a well-cured sugar beet pulp from the silo, and where the conveniences are not to be found for keeping it in a suitable condition it may be well to ensile it in a fresh condition from the factories. It has been found in feeding experiments that when alfalfa hay is worth $5 per ton, sugar beet pulp is worth $1.50 per ton for feeding purposes. It requires nine pounds of sugar beet pulp to equal one pound of corn or two and one-half pounds of alfalfa hay for steers. In California a number of steers fed on sugar beet pulp and alfalfa hay returned a considerably larger profit than when corn, barley, and oats were added to this basal ration. It may be estimated that one ton of pulp is equal to four hundred and twenty-one pounds of corn stover or two hundred and forty-seven pounds of mixed hay or sixty-nine pounds of mixed grain for fattening steers. In another set of tests undertaken in Michigan the feeding value of sugar beet pulp was somewhat higher. In Utah steers made a pound of gain

from eleven and one-half pounds of alfalfa and thirty-one and one-half pounds of pulp at a cost of two and eight-tenths cents. Tests in Utah showed that those steers which received pulp and alfalfa made the smallest daily gains, but yielded the largest profits.

ANIMAL FEEDS

It is a well-known fact, which has been demonstrated by numerous feeding experiments, that animals which are naturally herbivorous may be taught to eat considerable portions of animal feed and show profitable returns from such material. Thus, dried blood may be added to the grain ration, gradually increasing the ration from a few ounces to one and one-half pounds daily toward the end of the feeding period. Blood meal when used at the rate of one and one-half pounds per day showed an increased cost of gain. Bone meal is readily digested by cattle. It is a frequently observed fact that cattle are fond of bones and they attempt to eat them when found lying on the ground. The feeding value of all kinds of animal foods for all kinds of stock which relish them and digest them readily is very high.

Molasses.—Molasses, sugar and syrup have been largely fed to steers, as well as to horses, and for similar purposes. Thus, in Utah it has been found that molasses fed in rations of four pounds a day with eight pounds of corn and sugar beet pulp ad libitum showed a feeding value of $2.35 per ton. In subsequent experiments steers were fed medium-sized rations of bran and shorts with the addition of eight pounds of molasses per day and alfalfa hay. The feeding value of molasses

in this test appeared to be about the same as in the previous one. The results from feeding molasses and sugar are not uniform. In a set of experiments in Scotland the growth of steers was somewhat checked and they went off feed when fed sugar in rations of one to two pounds per day.

Feeding Methods.—A number of matters connected with the profitable feeding of steers remain to be considered. Statistics collected among over five hundred cattle raisers in Illinois show that about forty per cent. of them found the most profit in fattening steers in summer, twenty-six per cent. in fall, twenty per cent. in spring and fourteen per cent. in winter. It has been found that about thirty days must be allowed to get cattle on full feed after the fattening ration is begun. The period usually occupied by feeders in working up from a maintenance ration to a fattening ration varies from fifteen to forty days. The length of the fattening period varies extremely under different conditions, ranging from three to six months. From the standpoint of economy, it is profitable to feed steers so long as they are gaining regularly a pound a day. It will be found in practice that some steers begin to lose appetite after a fattening period of one hundred and fifty days. In Minnesota it has been found that steers give a much greater profit from a medium grain ration for one hundred and forty days than when forced on a large grain ration for eighty-four days. Not all steers can be depended upon to endure sufficient forcing to put them in a market condition in so short a period as eighty-four days. The southern feeder will do well to begin feeding his cattle not later than November fifteenth to Decem-

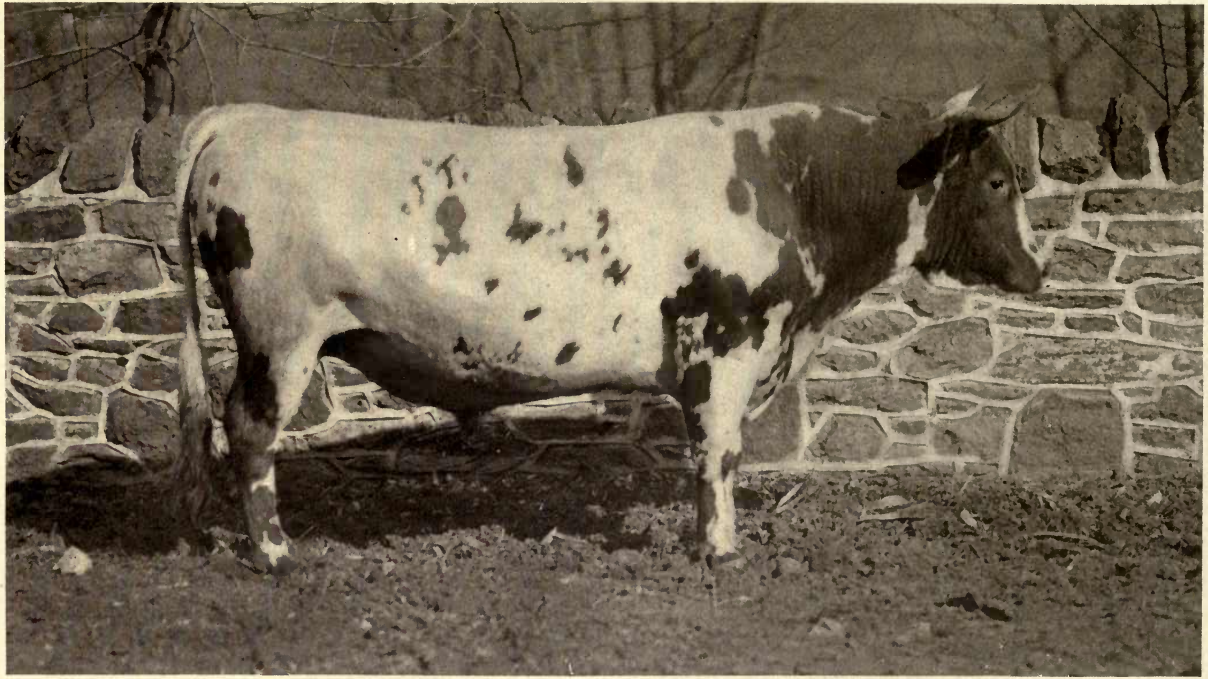
ber first. They can then be fed until the middle of April, making a feeding period of one hundred and fifty days, and during this time, if proper rations are given, they should gain from one and one-half to two pounds per day. The shorter feeding periods will usually not be found profitable.

The number of feeds per day in fattening steers is almost universally two, and there appears to be no reason for changing the common practice of farmers and feeders in this respect. Farmers vary greatly in the amount of feed given steers on full rations. Thus, in Illinois it has been found that twenty-five per cent. of the cattle raisers give yearlings all the grain they will eat while others feed one peck of corn. This ration is usually in addition to bran, oats or some other nitrogenous ration. Yearling steers on grass are seldom fed more than one peck of corn a day. Two-year-olds in winter are fed corn ad libitum, but in a much larger percentage of cases it is measured out in rations of one-half bushel per day together with two to five pounds of bran or linseed meal. Two-year-olds on pasture receive usually a similar quantity of grain, even during the winter. The profitable amounts of different grains to be given fattening steers have already been stated in the discussion of the different feeds.

Among farmers and feeders the average gain of cattle is about two and seven-tenths pounds per day in summer on pasture with grain, and two and two-tenths pounds per day in winter. The amount of feed required for one hundred pounds of gain varies, according to the experience of different farmers, from four to twenty bushels of grain in winter and from ten to sixteen bushels

in summer. The feeding effectiveness of different grains has been mentioned above. The amount of hay required for one hundred pounds of gain varies in the experience of farmers from four hundred to one thousand pounds. These points, however, are really not observed carefully enough by the average feeder. The length of the feeding period has been found to exercise an influence on the rate of gain. Thus, cattle gain most readily at the beginning of the forcing period and gradually diminish in the rate of gain until finally no further gain is possible. This point seems to be at the limit of the animals' toleration for a forcing ration. This fact, therefore, should have some influence in determining the length of the feeding period. In Canada it has been found from careful computations that the cost of one hundred pounds of gain for a one hundred and sixty day period is $10.50 and for a one hundred and seventeen day period $12.75, the average daily gain during a feeding period of one hundred and nineteen days was one and eight-tenths pounds, while the average daily gain in a period of one hundred and seventy-four days was one and six-tenths pounds.

Numerous experiments have been made regarding the value of exercise for steers during the fattening period. In Canada it has been found in a test of fattening tied and loose steers in stalls that the loose steers made a larger absolute gain than the tied steers and at a smaller cost. The rate of gain per day was also higher in the loose steers. In nearly all feeding experiments where attention has been given to the value of size in steers it has been found that there is more profit in a heavy than a light steer.



Photograph furnished by C. M. Winslow.

AYRSHIRE BULL—A LARGE DAIRY ANIMAL OF UNUSUAL HARDINESS.

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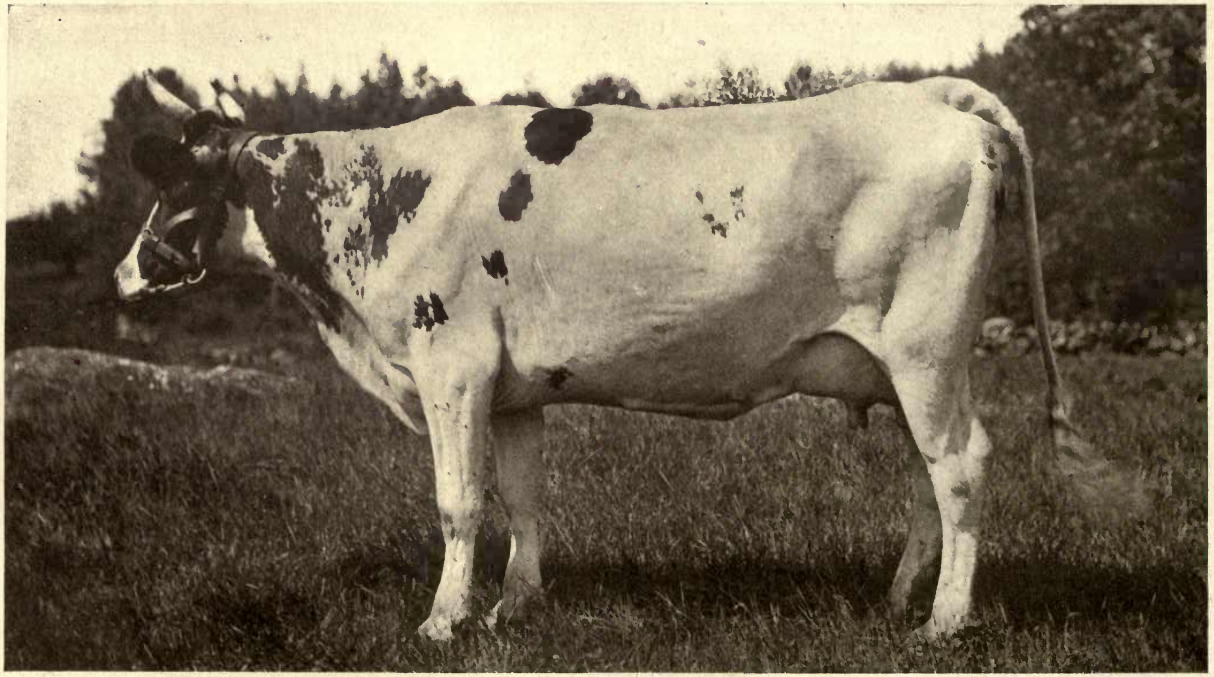

Photograph furnished by C. M. Winslow.

AYRSHIRE COW—A HEAVY FEEDER AND A GOOD MILKER.

Age and Cost of Gain.—The hundreds of feeding experiments which have been carried out with steers show conclusively that the rate of gain is greater in young animals and decreases with the increase in age. This is true not only of steers, but also of sheep, hogs and poultry. It is of considerable economic importance, therefore, to bring steers to market maturity as early as possible, since the greater the gain the greater the profit and the less the cost in caring for the animals. Statistics based on more than fifty thousand cattle fed under careful observation show that the rate of gain in yearlings is nearly twice that of four-year-olds.

The question is frequently asked how returns from beef cattle may be increased. When this question was proposed to Illinois beef raisers a variety of opinions were given, but the majority considered that the best results would be obtained from the use of more well-bred cattle, more intelligent use of feeds, cheaper stockers and feeders, cheaper feeds, more pasture of good quality and better care of cattle. In Massachusetts the question has been answered by farmers essentially in the same way, since they recommend in order to obtain greater returns from feeding cattle that better strains should be used, better feeding methods adopted, steers should be brought to maturity earlier and pastures should be improved. Likewise in Alabama the essentials to the highest profit in beef production are considered to be the use of thoroughbred bulls, abundance of good pasture, extension of the cultivation of cowpeas, alfalfa, sorghum and other similar crops, and the employment of men better acquainted with the management of beef cattle.

Shelter.—Considerable controversy has raged around the question as to the amount of shelter which should be given to steers during the fattening period in winter. In some climates it has been found that excessive cold weather is likely to retard the growth, especially, of young cattle, and some feeders have even recommended the use of artificial heat in barns during January and February. As a rule, however, where careful experiments have been carried out it has been conclusively demonstrated that steers make much better gains when allowed the freedom of yards, protected from storms and severe winds, than when kept in barns, or tied in stalls. As the result of past experience more than sixty per cent. of Missouri feeders prefer an open shed for fattening steers, twenty-three per cent. barn yards, and only seventeen per-cent. barns. In Illinois about one-half of the cattle raisers give their cattle the freedom of open sheds. It is apparent from numerous experiments, which have been carried out along this line, that while theoretically cattle may have to eat a little more to make up for the loss of heat in open sheds, nevertheless from a practical standpoint their health and vigor are much better, the appetite is more active and, therefore, as a general result gains in weight are made more economically in sheds than when confined in stables. The Pennsylvania Experiment Station has been carrying on a series of experiments on this question for a number of years. As a result of three years' work it appears that the actual amount of feed eaten by steers in outside lots is less than that eaten by steers in barns. The gains made by fattening steers were not increased by keeping them in warm quarters and it is concluded that

it is not possible to have stables or shelters too cold for fattening steers in a climate like that of Pennsylvania, provided the animals are kept dry and properly bedded.

Salt.—Among the cattle raisers of Illinois eighty-five per cent. use barrel salt, while seven per cent. use rock salt. Sixty-five per cent. of the feeders keep the salt before the cattle all the time and thirty-five per cent. feed it at regular intervals. On the western ranges it is customary to use rock salt in large chunks placed in certain localities which eventually become known as cattle licks.

Water.—It is a matter of some importance that the supply of water should be abundant and clean. The economy of this matter will determine whether liberal expenditures for self-watering devices should be incurred or not. As a rule, it has not been found desirable to warm water in winter, except where there is danger of freezing. So long as water does not freeze no economy has been found in supplying artificial heat.

Breeds as Related to Gains.—Among Illinois cattle raisers fifty per cent. believe that Shorthorns give the best result, twenty per cent. favor the Herefords and eighteen per cent. the Angus. This is, however, somewhat a matter of opinion. In careful experiments carried out under scientific conditions the gains in different breeds have not been found to vary appreciably and no conclusions can be drawn from such experiments. As a rule fine grades or pure-bred beef breeds give better results than poorly bred animals, but even this conclusion cannot be deemed infallible, for in some instances scrub cattle have yielded larger returns than pure breeds when kept under the same conditions.

The Beef Type vs. the Dairy Type.—There is abundant reason why the beef type should be preferred to the dairy type in beef production. In the first place, it has been bred for producing a suitable beef form and the high-priced cuts are present in larger proportion in beef animals than in the dairy type, at least, as a rule. Then, too, the percentage of dressed weight is somewhat higher in beef cattle than in dairy cattle. In Kansas it has been found that steers of the dairy breeds when properly handled make good beef, but not of so high a quality as that secured from well-bred beef animals. The cost of feeding for one hundred pounds of gain in the Kansas experiment was $15 for Shorthorns, $17 for Angus, $15 for Jerseys, $15 for Holstein, and $14 to $17 for scrub cattle. The relative value of beef and dairy animals for beef production has been thoroughly tested at the Iowa Experiment Station, where it was found that dairy steers showed a higher percentage of offal and a lower percentage of dressed weight with more fat on the internal organs and a larger percentage of cheap cuts. There was, however, little difference in the fineness of grain or quality of the meat. In a recent series of experiments in Minnesota a Jersey-Holstein steer cost less to raise and fatten to the age of thirty-eight months than beef steers up to twenty-two months. The dairy steer in this case dressed five per cent. less, but actually carried a higher percentage of loin and higher-priced cuts and, therefore, made good for the lower percentage of dressed weight. Experiments have shown conclusively that steers from Jersey cows and Angus or Hereford bulls make excellent baby beef. Such cross-bred steers readily pass for Angus or

Hereford and thus the possibility of combining dairying and beef production in a most economic manner is realized.

In a comparison of western and southern steers for beef production in Iowa it was found that cattle from southern ranges may be taken directly to Iowa feeding lots and used for feeding purposes. Under these conditions when fed on the same feeds as western steers they gain as fast or even faster than the range steers. Southern steers have been found to take on flesh readily and can be brought to a market maturity in a satisfactory manner.

Heifers are usually bred for beef production during the spring after they become two years old. Some difference prevails in this matter, however, so that the breeding age of heifers ranges from 12 to 36 months. As a rule probably the best results are obtained from breeding heifers at the age of two years.

The extent to which pure-bred bulls are kept for the production of beef cattle varies greatly in different parts of the country. In Illinois about 87 per cent. of the raisers keep pure-bred sires, the remainder using grade bulls. The pure breeds stand in the following order in point of numbers: Shorthorn, Hereford, Angus, Red Poll, Polled Durham and Galloway. The question is often raised by the farmer as to whether he can afford to buy thoroughbred bulls for the production of beef. This may be answered in different ways. If the farmer has only a few cows and is not in a position to raise fine beef after the most approved methods of feeding and care, it will not prove profitable for him to buy pure-bred bulls. In other words if a large initial expense is to be incurred for the purchase of fine stock it is necessary

to give special care to these animals in order to secure the necessary profit to repay the higher price paid for the original stock. Thus where a man has but a few cows and can buy a good grade bull for $25 or $30 it would hardly seem advisable for him to go to the expense of buying a thoroughbred Angus, Hereford or Shorthorn at a cost of $200 to $300. We do not hereby wish to discourage the improvement of beef cattle. In order to prevent the use of grade bulls it will probably be best for several farmers to buy a thoroughbred sire in partnership provided any individual does not keep enough beef cows for the entire service of the bull.

If polled breeds are not used it is desirable to dehorn calves as soon as the horn button appears. This is much more humane and causes less check in the growth of the animal than to remove the horns after the steers have become mature. In calves three to four days old the hair may be clipped away from the horn button and a stick of caustic potash, wrapped in paper to protect the fingers, is moistened on one end with water and rubbed over the horn until it becomes sensitive. This process may be repeated several times. Within a few days a scab appears over the horn button and later falls off leaving the poll hornless. Mature steers require about two weeks to recover from the process of dehorning. Otherwise very little bad effect has been noted.

Throughout the range country branding is necessary for the identification of ownership of cattle This, as is well known, is almost universally done by means of a hot branding iron. From time to time various branding fluids have been proposed as substitutes for the branding iron on the ground that the process is less repulsive and more humane.

In Arizona as well as in Queensland and New Zealand branding fluids have been tested on a small scale. It has been found that although the brands were legible at first the design gradually became less conspicuous and when the animal was killed and the hide tanned the leather was found to be injured to about the same extent as after branding with a hot iron.

DISEASES

Tuberculosis.—Among the various diseases which affect cattle tuberculosis is by far the most important. This disease attacks not only cattle but also all other domestic animals including poultry and man as well. The disease is caused by the tubercle bacillus, which gains entrance to the alimentary tract in the feed or to the lungs in impure air. The percentage of infection increases with the age of cattle. Thus in calves only a small part are infected while in old dairy cows from 15 to 60 or even 90 per cent. of the animals in individual herds are affected with this disease. Tuberculosis appears in the lungs or all of the lymphatic glands of the body, upon the vital organs and even the skin. The progress of the disease may be rapid or slow. The disease, therefore, may at once become apparent or may be hidden for years. The tubercle bacilli are rarely found in the meat even in advanced cases of tuberculosis. The milk of tuberculous animals is, however, always dangerous and should never be used without previous sterilization by heating.

A long and bitter controversy has raged over the identity of human and bovine tuberculosis. It has finally been demonstrated beyond question, however, even to the disciples of Koch, that cattle may

become infected with tubercle bacilli from man and man in turn with tuberculous milk or meat. The disease may be detected by the use of tuberculin, which is usually administered by state sanitary officers. This material gives a fever reaction in diseased animals and no reaction in healthy ones. They may thus be divided into two lots and the infection prevented from spreading to the healthy animals. Recently various German, French, English and American investigators have found an apparently satisfactory method of vaccinating cattle so as to render them immune to the disease. For vaccine tubercle bacilli from man are used after being reduced in virulence. A mild form of the disease is thus produced from which the animals recover and later are not subject to tuberculosis.

Texas Fever.—This is the most important cattle disease of the southern states and has long caused serious loss to the agriculture of that part of the country. Texas fever is caused by a blood parasite which destroys the red blood corpuscles, causes a high fever, rapid emaciation and death in a large percentage of cases. The blood parasite is carried from the diseased animal to healthy ones by the cattle tick and without the agency of this tick Texas fever cannot be distributed. It is evident, therefore, that in order to control this disease effectively it is desirable to attack the cattle tick. On account of the difficulty of its extermination, however, and the belief by a large percentage of investigators that the extermination of the cattle tick was impossible, attention was first turned to a method of immunizing cattle against the disease. The Bureau of Animal Industry and a number of experiment stations have worked out a very successful method according

to which susceptible cattle are inoculated with a small quantity of blood of the cattle which have recovered from Texas fever. This inoculation gives a mild form of the disease from which ninety-five per cent. or more of the animals recover and are, thereafter, immune. The importance of this method is obvious when it is considered that all dairymen and beef raisers in the South are desirous of improving the quality of their herds. In order to do this they must import high-bred cattle from the North and these cattle, being susceptible to Texas fever, will take the disease and die in seventy-five to ninty per cent. of the cases unless previously vaccinated. Within the past few years, the belief has gained ground that it is possible to exterminate the tick and thus eradicate the disease completely. Thus, in North Carolina, Louisiana, Tennessee and elsewhere it has been shown that by a simple rotation of pasture and cultivated fields the ticks can be starved to death and cattle entirely freed from them. In North Carolina the State Veterinarian, at an expense of $6 per farm, has entirely exterminated the cattle tick in ten counties and placed this large area above the quarantine line. The cattle tick constitutes a serious danger not only to all cattle in the South, which have not become infested with the cattle tick during calfhood, but to all northern cattle taken south of the quarantine line without vaccination. It also stunts all cattle which are badly infested and delays their maturing so that it costs more to feed them, preventing in many cases their breeding until they are three or four years of age. A considerable appropriation has been placed at the disposal of the Bureau of Animal Industry to use in co-operation with various southern states in

the attempt to develop means for the extermination of the cattle tick.

Abortion.—This term is used to mean premature birth of the calf from whatever causes. In many cases it may be due to the sudden onset of some disease accompanied with high fever or to bloating or other digestive disturbances. Occasionally abortion is caused by eating grass or grain infested with ergot. This form of abortion, however, does not acquire much importance. The most serious form is infectious and is transmitted from one member of the herd to another, especially from the bull to the cow. Cows which have once aborted are thereafter rendered useless for breeding purposes for the reason that it is usually impossible to sterilize thoroughly the reproductive organs of the cow. The only treatment for this disease, which at times assumes very serious proportions, is one of antisepsis, that is, the reproductive organs and the hind quarters of the aborted cow should be thoroughly washed with a solution of corrosive sublimate in water at the rate of one part in one thousand or a one per cent. solution of carbolic acid or some similar disinfectant. The aborted calf and the membranes should also be burned or otherwise destroyed so as to prevent the spread of the infection.

Anthrax is one of the oldest-known infectious diseases and is called charbon in the southern states and sometimes carbuncular disease. It affects not only cattle, but also sheep, goats, horses, dogs, cats and other carnivorous animals. The disease may also be transmitted to man. In one form of anthrax the animal suddenly falls down and dies without the existence of previous symptoms. In acute cases the disease begins with a

high fever and results in death within two or three days while occasionally the course of anthrax is slower. Anthrax exists as a continuous infection in a number of areas in the southern states and has long been known to thrive best in certain localities in the central states where extensive outbreaks have occurred as a result of the infection of water from tanneries and other sources. The disease is perhaps most frequently transmitted by means of infected hides used in tanneries and by the agency of scavenger animals such as turkey buzzards, dogs, cats, etc., which feed upon animals dead of anthrax. In order to prevent the distribution of the disease it is important that the animal carcass be buried or burned. This should be done without previously cutting open or skinning the animal since by such operations the bacillus of the disease may be widely scattered.

Blackleg.—This disease, which is often confused with anthrax, may be distinguished from it by the fact that in cases of black leg the swellings which appear underneath the skin crackle under pressure with the hand owing to the development of gas in the tissues, while the anthrax tumors are entirely free from gas and show a consistency like dough. Moreover, in cases of blackleg the spleen is not enlarged as in cases of anthrax. Furthermore, anthrax is readily infectious for nearly all animals while blackleg is not. Blackleg attacks most frequently calves between ages of six and eight months. The disease rarely appears in calves under six months and is scarcely ever seen in old animals. Man, horses, hogs, dogs and cats are immune to blackleg. The prevention of blackleg is accomplished by means of a vaccine which has been used extensively throughout the

civilized world. In this country the vaccine is prepared by the Bureau of Animal Industry, various state experiment stations and by a number of drug firms. During the past six years the Bureau of Animal Industry has distributed nearly 8,000,000 doses of blackleg vaccine for use in the area where this disease prevails most extensively. The amount of loss from blackleg after vaccination has been reduced to less than one per cent.

Big Jaw, also known as lumpy jaw, wooden tongue and by various other terms, is an infectious disease due to a bacterial organism known as the ray fungus. Big jaw attacks not only cattle, but also horses, sheep, deer, pigs and man. The most common location for the disease is in the bone of the lower jaw which it causes to become spongy and enormously enlarged. The bone tumor thus formed may break through to the outside and discharge. Big jaw may be treated by cutting away the tumor and by administering iodide of potash. This drug has been found to be a specific for the disease. After giving it daily for one week in doses of eight to twelve grams, then withhold for two or three days, repeat again for another week and the organism which causes the disease is destroyed completely. Big jaw is not readily infectious and on this account much controversy has arisen regarding the question whether the meat of such animals is dangerous. In general it can hardly be considered so and, unless the internal organs are affected it may be passed as wholesome meat.

Foot and Mouth Disease.—This plague of cattle, sheep, goats, and hogs fortunately does not occur at present in the United States. In 1902, however, a serious outbreak occured in New England which

was promptly attacked by the Bureau of Animal Industry in co-operation with the state authorities and completely eradicated. The method of attack consisted in killing and burying all diseased animals and paying an indemnity to their owners. Foot and mouth disease is exceedingly infectious and spreads rapidly throughout the herd. It may be recognized by the formation of eruptions on the foot and in the mouth and swelling upon the udders. As a rule it does not cause death in affected cattle, but the milk from such cows is exceedingly dangerous to man. Occasionally the disease may be complicated with pneumonia or the loss of the hoofs, in which case the animals must be slaughtered. A vaccine method has been devised for this disease, but is not very successful. In Italy good results have been claimed from inoculation with a dilute solution of corrosive sublimate. The effectiveness of this method also remains in doubt.

Milk Fever.—This is a dangerous disease peculiar to the cow and particularly heavy milkers. It ordinarily occurs shortly after calving, but sometimes appears not to be directly connected with this function. The name is somewhat misleading since ordinarily there is not a high fever, but, on the contrary, a lower temperature than normal. The cow becomes dull and unable to walk. She lies upon the breast bone with the head thrown around upon one side. Many remedies have been proposed for this disease, the first of which consisted in the use of aconite and cold packs on the head. Later, Schmidt worked out a very successful method of treating the disease by means of the injection of ten grams of iodide of potash into the udder. After this treatment a

large percentage of cows recover. Recently, however, it has been found that the disease may be successfully controlled in nearly all cases by the injection of any inert substance into the udder, as for example, warm water, oxygen, or ordinary air. The last method has been extensively used and has given the best results of all treatments. For the injection of air, it is simply necessary to have a tube of the right size to fit the milk duct, connected by means of a rubber tube with the air pump. The udder is then tightly distended with air after which the affected cow shows a rapid recovery in ninety per cent. of cases or more.

Garget is an inflammation of the udder also known as mammitis and may occur in varying degrees of severity. A mild case may yield to treatment with hot poultices or manipulation with the hands. Occasionally the disease is infectious and then great care must be exercised to prevent the spread of the disease. Some benefit has been found from the use of an ointment containing three ounces of belladonna in eight ounces of vaseline. In cases of infectious garget the affected quarter of the udder may become so changed in structure as not to secrete milk thereafter.

Bloating is due to the formation of gas in the rumen or first stomach. Alfalfa, clover and corn stalks appear to be most susceptible to fermentation and are, therefore, most likely to cause bloat. If the production of gas in the first stomach is not too extensive it may be checked by administering drenches of soda or by giving lard or some inert oil. In violent cases where such a remedy would act too slowly immediate relief is obtained and the animal's life is saved by thrusting a knife through the left side of the body at a point a few

inches in front of the thigh bone below the process of the back bone and behind the last rib. At this point the stomach is firmly attached to the body wall so that the gas escapes through the opening to the outside. The wound caused by the operation heals readily under ordinary care.

Mange is a disease caused by a mite, which closely resembles that of horse mange and sheep scab. This prevails most extensively on the ranges of the far West. The affected cattle rub themselves, and the hair comes loose in patches. The only successful treatment for this consists in plunging cattle into a dipping vat containing lime and sulphur in the proportion of twenty-one pounds sulphur and seventeen pounds lime to one hundred gallons of water or from the use of some of the proprietary remedies prepared for this purpose and readily obtained on the market.

Cattle besides being affected with numerous other diseases of less general distribution such as corn stalk disease, joint ill, septicemia, etc., are frequently attacked by horn flies, ox warble fly, buffalo gnat, etc. The ox warble fly punctures the skins and, thus, the hides are reduced in value. The horn fly worries cattle and causes considerable loss in weight during the summer season. Many preparations have been concocted for spraying on cattle to keep flies away. The best success has been obtained from the use of the ordinary kerosene emulsion which may be sprayed on the hair at frequent intervals at a very slight expense. Buffalo gnats prevail in the Mississippi valley, especially after extensive inundations. In some instances they occur in such numbers as to cause great loss in cattle. The cattle may be protected to some extent by the use of smudges.

CHAPTER IV.

THE DAIRY COW

The dairy industry is perhaps the most important single line of farm work in the United States at the present time and is rapidly becoming more and more important. This country was not at first greatly interested in dairying, but the profits to be derived from the proper management of dairy cows are gradually inducing an increased number of men to engage in this business. In fact, as population increases and becomes more dense, it cannot be otherwise than that the dairy industry will continue to become relatively more extensive and more important. While foods are cheap, pasture to be had practically for nothing, and while little labor is required for the management of cattle, sufficient returns may be obtained from beef animals to pay for the money invested. As soon as population becomes dense, however, and the price of all feed stuffs and labor connected with the production of beef increases, the profits to be derived from beef production are greatly cut down, and the beef raiser must practice all possible lines of economy and exercise shrewd business ability in order to avoid failure. Dairying, however, is much more susceptible of an almost unlimited development under conditions of dense population. In the first place, dairy cows do not require any extensive pasture. They may be more economically kept

on silage, roots, hay and soiling crops fed to them in the stable or open shed with the addition of a suitable grain ration. The acreage required, therefore, for the maintenance of dairy stock is not a serious proposition, partly for the reason that dairy cows are able to utilize legumes and other coarse foods to an extent which is possible with no other animal.

Then, too, there is a striking difference in the economy of milk production and beef production. From a long series of careful tests it has been found that a dairy cow can make a pound of milk out of a pound of dry matter in her feed while the best beef steers of the most improved breeds require from ten to fifteen pounds of feed to make a pound of beef. In other words it requires about ten times as much food to produce a pound of beef on the beef steer as a pound of milk from the milch cow. The relative economy in these two lines of industry is not at once apparent from this statement. In the first place, it may be objected to this unfavorable showing for the beef steer that his value for beef is much higher than that of the dairy cow and that her only value lies in the production of milk. On the other hand the dairy cow at the end of her period of usefulness in milk production may be fattened so as to yield a fairly good carcass of beef, and she thus pays for her keep during the time when she is not producing milk. It must be admitted that beef is the most expensive form of animal product which we can produce. The beef steer requires fully one-third more food to produce a pound of beef than does the sheep for the production of a pound of mutton. Similarly, the beef steer requires twice as much food in making a pound of beef as does the pig in

yielding us a pound of pork. Domestic fowls are also much more economical in the manufacture of a finished product than are beef animals. Since, as already stated, the dairy cow can produce ten pounds of milk on the material required by the beef steer for the production of one pound of beef, it is perfectly obvious that the production of beef is a luxury which can only exist so long as the price of feed stuffs and other conditions are favorable. It must also be obvious that as the cost of production increases, beef will become more and more a luxury and a greater economy of production will be found in a more extensive practice of dairying.

BREEDS

In order to start in the right way in the dairy business or to improve an already existing herd, it is necessary to select cows with reference to their milk yielding properties. There is a dairy type as well as a beef type of animal. The dairy type differs from the beef type in that the form of the dairy cow is in general that of a wedge, the body being deeper behind than in front with a large capacity for digestive organs and milk production. The general outlines may also be angular, at least far more so than in the beef type. These differences, however, must not be insisted upon too strongly for they do not always exist. In fact, about all that can be said in particular regarding the differences between the beef type and the dairy type is that a larger percentage of beef animals are better adapted for the production of beef and that a larger percentage of dairy cows are better adapted for the production of milk than is the case with the beef breeds. Individuality, however, is

the keynote of success in selecting dairy cows. The dairyman does not keep his cows because they conform to a certain type, but because they give milk and the only reason for selecting the improved dairy breeds for this purpose is that a larger percentage of these animals are likely to be good milkers.

Holsteins.—This breed comes from Holland and has been referred to in literature for nearly two thousand years. It was introduced into America quite early in our history and has become a popular breed on account of its high milking qualities. At present the Holsteins are kept in every state in the Union. In number the Holsteins are second only to the Jerseys. They have a large body, showing a capacious development for milk production. In size, this cow is the largest of the dairy breeds in the United States. One of the chief virtues of the Holstein is its enormous milk production. In that point it is superior to all other breeds. The percentage of milk fat, however, is somewhat lower than in other dairy cows. They mature perhaps somewhat later than the smaller breeds, but are exceedingly valuable in grading up a herd of dairy cows from scrub cattle. The color is black and white, the relative proportion of the different colors varying greatly. Thus, in some cases the ground color may be white with black spots while other animals are black with white spots. The colors are never mixed and the spots are sharply defined.

Ayrshires are by no means so popular as the Holsteins, but are hardier than most other dairy cows and mature quite early. The average milk yield, however, from these cows is as great as any other breed, but there have been no such examples

of enormous yields as have been obtained from Guernseys, Jerseys, and Holsteins. The color is red, brown or white or a mixture of these colors with all the spots quite sharply defined.

Guernseys come from the island of Guernsey and are closely related in their early development to the Jersey. They have become widely distributed in the United States and are increasing in popularity. The Guernsey appears to be best adapted to climates of moderate severity. They mature somewhat more slowly than the Jersey and on the whole are excellent dairy cows with few prominent weak points, but with a slight tendency to be delicate, especially in herds where the breeding has been careless. The color of this breed may be red, fawn, orange or lemon, with various white marks. The muzzle is frequently of a buff color. The Guernsey gives milk of a high fat content and is an economical user of food stuffs. Recently a Wisconsin Guernsey made a new world's butter record of one thousand pounds in a year.

Jerseys are perhaps better known than any other breed of dairy animal in the country. They came originally from the island of Jersey and have been imported into the United States since 1853, or perhaps a little earlier. At the Columbian competitive test, in 1893, the Jersey carried off the prizes in competition with Guernseys and Shorthorns. They are distributed throughout the country, but are most numerous throughout the middle and eastern states. For the individual who can keep only a cow or two the Jersey is unquestionably the breed, being docile and easily managed and enduring confinement as well as any other breed of cows. They are also equally valuable in large herds and yield milk of a high fat content. Jerseys

are easily kept and, therefore, produce milk on a very economic basis. One of their chief defects is their small size and tendency to delicacy, especially where they have been inbred, and a relatively slight adaptability to the production of beef. This is a matter of some importance in dairy breeds since the steers must be sold for beef and the cows are used for this purpose at the end of their milk giving period. The color of the Jersey varies greatly from fawn and white to gray, cream color, shades of red with steel gray and other colors showing black points. The muzzle usually shows considerable black. Jerseys are much smaller and of finer structure than the Holsteins, with a greater tendency to a straight back than the Ayrshire and with somewhat finer bone than the Guernsey.

Devons are an ancient breed of cattle from England. They are essentially a dual-purpose breed, being well adapted for the production of beef as well as milk. The Devon was first introduced into the United States in 1817 and has gained considerable popularity. They are active, good grazers, somewhat smaller in size than the Galloway and are noted for the high percentage of fat in the milk. In the production of beef their chief weakness is lack of size. The Devons are of a uniform red color with a white spot occasionally on the udder.

Dutch Belted cattle come from Holland, where they have been held chiefly under the control of the nobility of that country. They were first introduced into the United States in 1838 and have thus far failed to make a large place for themselves in this country. They are not lacking in hardiness, and in size are intermediate between the Holstein and Guernsey. They mature with moderate rapidity and utilize their food with medium economy.

According to the tests which have been made in this country they are somewhat lacking in vigour. The milk yield, however, is excellent. The color is black with a sharply defined, broad white band extending around the body between the hips and the shoulders.

In addition to these breeds of dairy cows we may mention French Canadian, Kerry, Brown Swiss, Holderness, Shorthorn, Polled Durham, and Red Poll. Some of these breeds are commonly referred to as dual-purpose cattle on account of their possession of the essential beef form and they have been referred to in the discussion of beef cattle.

FEEDING DAIRY COWS

In feeding milch cows a number of systems are in vogue, depending largely on the kind of feeding stuffs which are most convenient for the farmer in different localities. In general, it should be remembered that the dairy cow is capable of utilizing a large amount of feed and turning it into milk. These cows are the biggest eaters and also produce the greatest amount of milk from their food. It is not enough, however, merely to give the cow an enormous quantity of food without regard to its quality. On the contrary, if any point has been definitely determined by experiments regarding the dairy cow, it is the fact that she needs a comparatively narrow ration, that is, one containing a large amount of nitrogenous material. There are obviously two ways to obtain this protein, either through purchasing nitrogenous feeding stuffs such as bran, cotton seed meal, middlings, linseed meal, gluten meal, oats, peas, etc., or by the use of leguminous forage plants such as alfalfa, clover, cowpeas,

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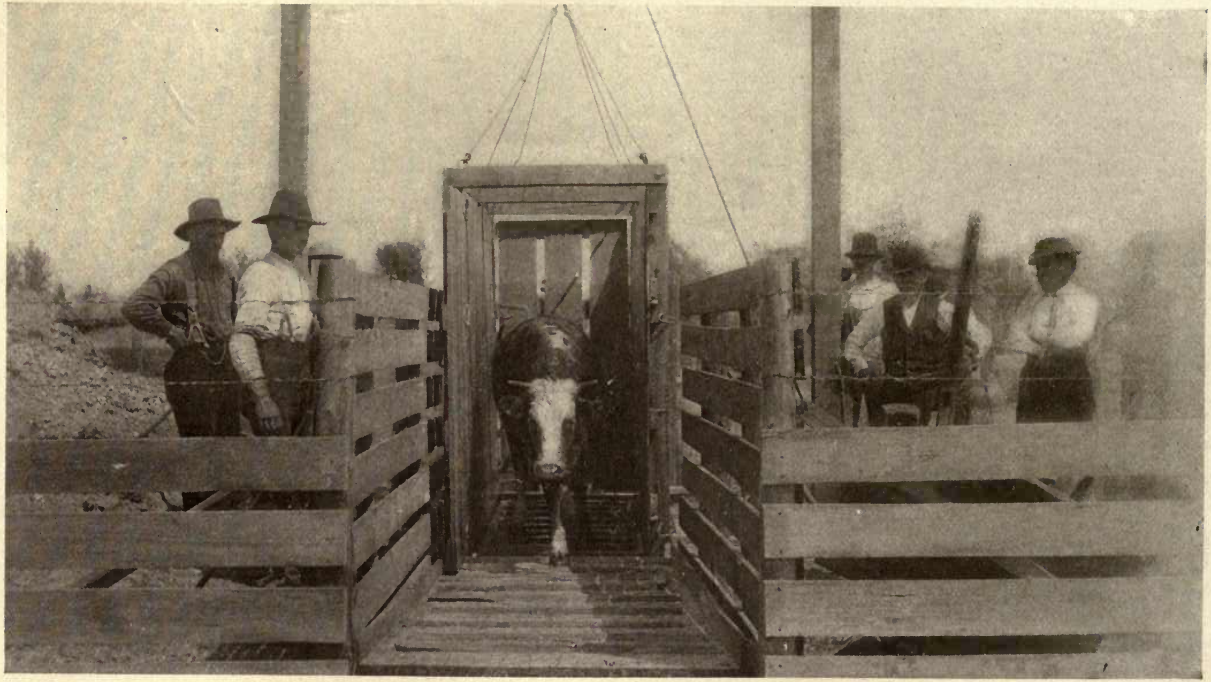
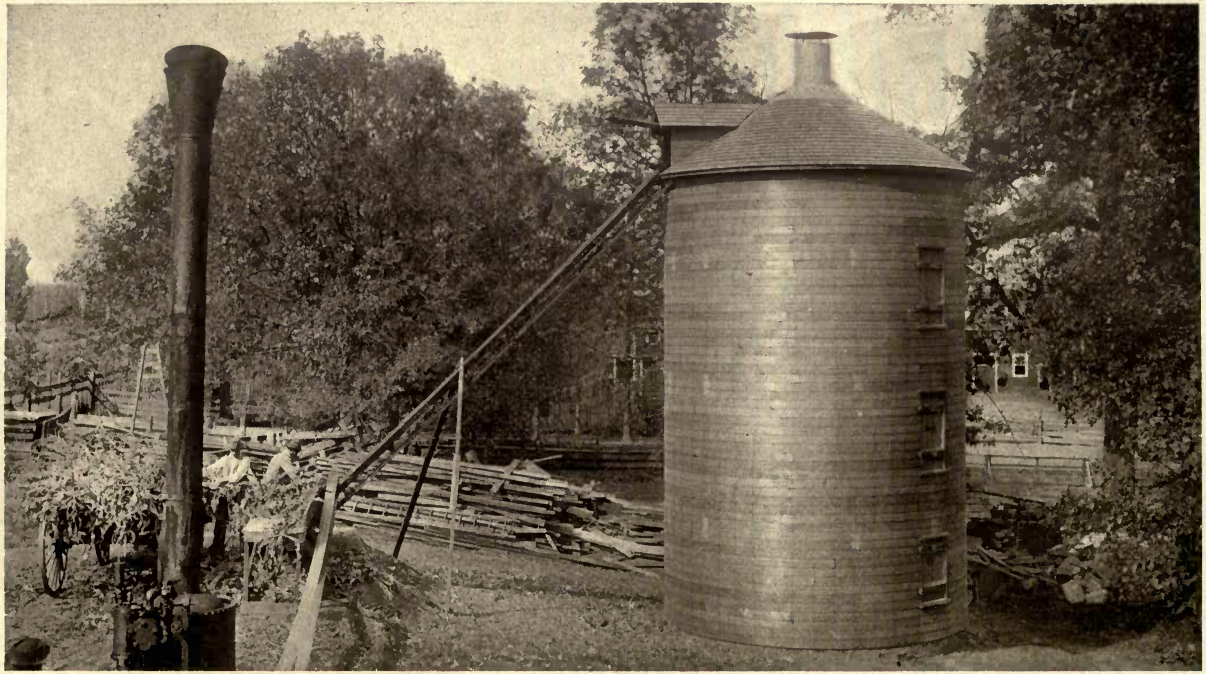


Courtesy of North Dakota Experiment Station.

CAGE FOR DIPPING CATTLE WHEN CURING THE MANGE.



FILLING A ROUND SILO—THE CHEAPEST WAY TO HANDLE CORN FOR MILK PRODUCTION.

vetches, soy-beans, field peas, etc. Cows, however, should always receive some grain, no matter what the rest of the ration may be. With regard to the size of the grain ration for cows it is, of course, necessary to graduate this according to the appetite and capability of each cow to utilize grain profitably. The grain ration varies in different instances and under different conditions from two to twelve pounds per day. Some cows may not be capable of utilizing economically more than two or three pounds a day while others can give good returns from twelve pounds or, in rare instances, even more. As a rule, the average cow cannot give profitable returns from a larger grain ration than about eight pounds per day.

As already stated some grain should always be fed in the ration for dairy cows. While they are kept on pasture the kind of grain will naturally vary according to the kind of forage plant which constitutes the pasture. Thus, on alfalfa, clover and cowpeas the grain ration may be largely corn, Kafir corn or other carbonaceous grain while on pasture of rye, wheat, timothy, sorghum, millet, and various other cereals and non-legumes, the grain ration should be more highly nitrogenous. Similarly in the winter the character of the grain ration should depend upon the kind of hay which is fed and the amount of silage and roots which complete the ration.

All dairy cows at all seasons of the year require at least two and for the most part three kinds of food, viz. grain, succulent material and coarse forage. The grains as already indicated may include nearly all of those raised on the farm. Succulence is obtained in the form of silage, soiling crops, pasture and roots, while dry roughage is

obtained from leguminous and cereal hays, corn fodder etc. A suitable mixture of these which can be applied almost universally with local substitutions is about eight pounds of grain, thirty-five to forty pounds of silage, and ten pounds of hay. For the silage, roots may be substituted if convenient, or a comparatively large ration of alfalfa hay, for example twenty pounds. It is, of course, not strictly necessary that the ration should contain succulent material, but better results in digestion and in the production of milk are always secured when some form of green or succulent material is contained in the ration.

In the list of the grains fed to the cows wheat bran is always an important one. Wheat may be fed in various forms such as bran, ground wheat, or even whole wheat, but as a rule wheat alone is not equal to mixed grains. Bran may be fed in combination with silage, soiling crops, or on pasture but in some instances is not quite so effective in a large silage or root ration for the reason that all of these feeds are slightly laxative. Where grain is fed to the extent of three to four pounds per day in the form of cotton seed meal and gluten meal in rations of two pounds each, bran should be fed at the rate of three pounds per day. The amount of bran which can be fed economically will, of course, depend on the relative cost of this material. In the southern states bran is considerably more expensive than cotton seed meal and for this reason should be fed in smaller quantities than in the North. When wheat bran is compared with cotton seed meal directly the usual finding is that cotton seed meal produces butter at from two to three cents per pound less cost than the bran. Coarsely ground wheat, however, may be used wherever

the market price of wheat is not too high, and with good results in milk production.

Buckwheat middlings is a favorite dairy food and has been shown in numerous tests, especially in Vermont, to be more effective than a combination of corn and bran. In some instances it produced more milk than the other common mixtures of grain feeds. Recently the meal of India wheat, which is really another species of buckwheat, has been tested and found to be a good substitute for wheat bran, cotton seed meal or linseed meal.

In all cases where a direct comparison has been made of the value of carbonaceous and nitrogenous rations for dairy cows the latter have given the best results. For this reason it is always desirable to balance corn or Kafir corn with some other grain or with alfalfa or some other leguminous forage plant. When corn is worth ten cents per hundred pounds, barley is worth ten cents, cowpeas fifteen cents, cotton seed meal twenty-eight cents, soy-bean meal twenty-three cents, wheat bran ten cents, wheat middlings twelve cents, linseed meal twenty-two cents, and other grains in proportion. Gluten meal is a product obtained from corn in the manufacture of starch and is highly nitrogenous. For milk production it is about equal to cotton seed meal and may be used in rations of three or four pounds. A similar statement may be made regarding hominy feed, germ meal and a large number of other milling products which may be obtained from corn.

Kafir corn is carbonaceous like corn and may be used as a substitute for it in feeding dairy cows. As a rule, it is about equally effective with corn. Naturally it will be fed only in those regions where it is grown extensively since, otherwise, corn is rather to be preferred. Soy-bean meal and the

meals of other leguminous seeds are highly nitrogenous and are indicated as valuable materials for balancing rations which contain a large amount of succulent material with a comparatively low percentage of protein. Among the various milling products which have been used for milk production brewer's grains and distiller's grains occupy important places. These materials are being fed more and more until at present it is difficult to obtain them at the brewery since they are contracted for long periods in advance. Brewer's grains are rather more nitrogenous than the whole barley since a part of the starch is changed into sugar and fermented out in the manufacture of beer. They may be used in rations of thirteen to fourteen pounds with excellent results. It requires about four pounds of wet grains to equal one pound of the dried grains. Some difference of opinion has prevailed regarding the effect of brewer's and distiller's grains on milk and butter. When used in rations of average size there appears to be no serious objection against them on this score. In Massachusetts, brewer's grains have been found somewhat more effective than wheat bran. Malt sprouts, another of the products of brewing, are about equal to gluten meal in feeding value. Regular distiller's alcohol grains have been found to be very effective in producing milk, while the rye grains are somewhat less valuable. Distiller's grains, when compared with cotton seed meal, were found to be somewhat more costly than the latter, but the percentage of fat in the milk was increased while the quality of the butter was slightly inferior to that produced by cotton seed meal.

Cotton seed meal is universally recognized as one of the most effective nitrogenous feeding stuffs whether

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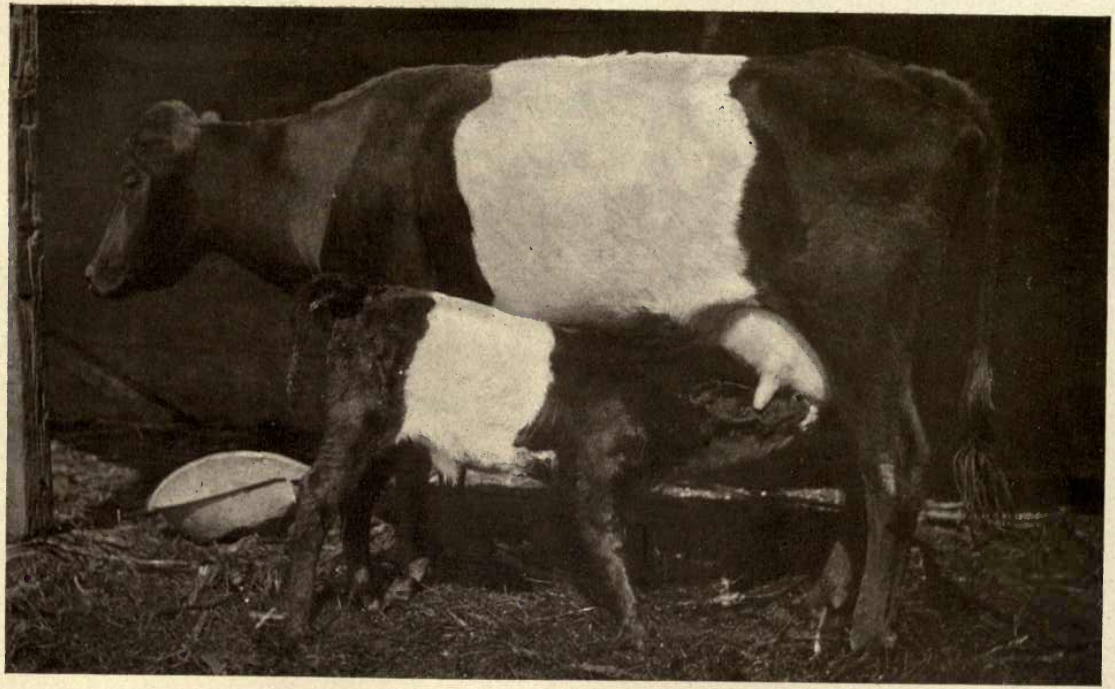
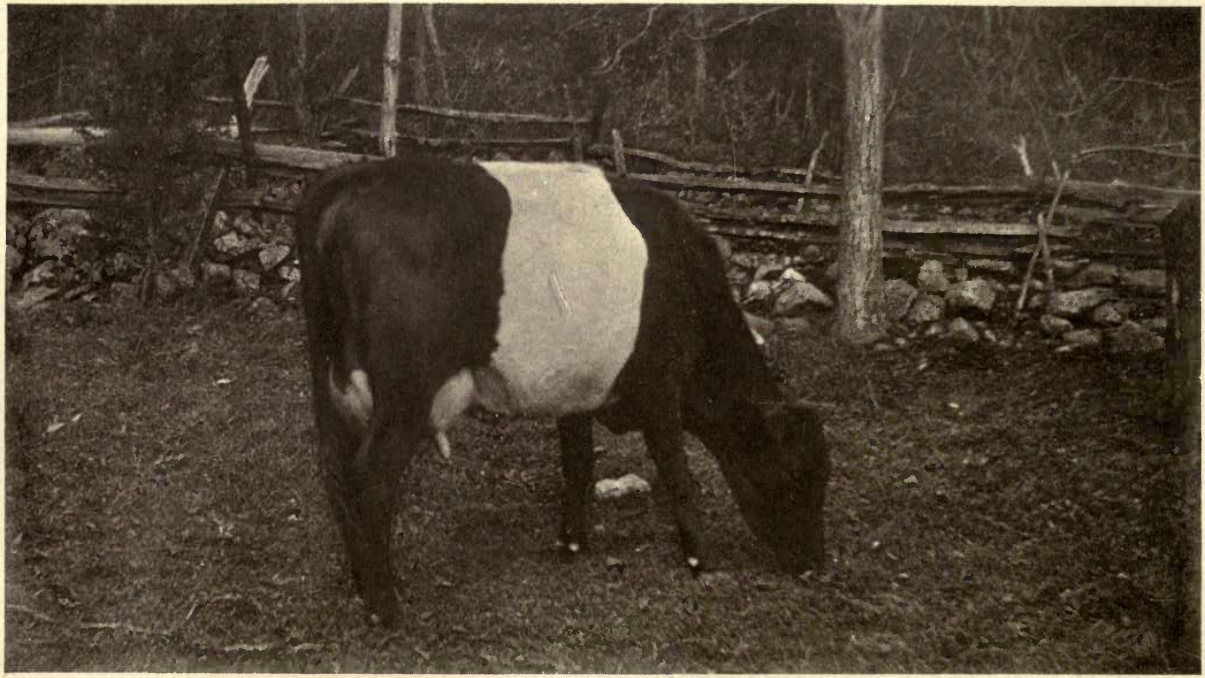


Photograph furnished by G. G. Gibbs.

DUTCH BELTED COW AND CALF.

The calf should get the milk for the first few days.



Photograph furnished by G. G. Gibbs.

DUTCH BELTED COW—ONE OF THE MOST STRIKING BREEDS AND A GOOD MILKER.

for the production of energy, meat or other animal products. For milch cows it is exceedingly effective and may be fed in rations of one to six pounds per day to balance other carbonaceous grains or coarse fodder. Naturally cotton seed meal is fed most extensively in the South, but it has also been tested throughout the northern states where it has universally given satisfactory results, when fed with other grains and when used in rations containing all kinds of succulent materials and coarse forage. When fed within reasonable limits it appears to have no injurious effects upon dairy cows. One fact which is noticed in the butter is that the melting point is somewhat raised so that butter from cows receiving cotton seed meal is unusually firm. Linseed meal is also used almost universally in the dairy. It has with dairy cows the same effect, as with other animals, regulating the digestive organs and adding to the thriftiness of the animal and the good appearance of the coat. It may be safely fed in rations as high as five pounds but this would not be profitable under ordinary circumstances. Fortunately, a much smaller amount, one to two pounds with wheat bran and corn is quite sufficient to produce the desired results. Speltz, emmer, oats, peas, beans, rye, sorghum, millet, and various other grains are fed to dairy cows in different localities with satisfactory results, provided, in each case the ration is balanced so as to contain a suitable proportion of protein and carbonaceous materials.

As already indicated, wherever the rations ordinarily fed by farmers to dairy cows have been studied with reference to their protein content and other rations suggested containing more protein, an increase in the amount of milk and

in the relative economy of milk production has almost universally taken place. It is obvious, therefore, that in order to obtain the greatest results from dairy cows this matter should receive due attention. Of course, the cheapest way to obtain protein is from home grown leguminous forage plants. Where this is not possible, it is necessary to purchase nitrogenous grains such as cotton seed meal, bran, linseed meal, etc.

Succulent Material.—Among the various foods, which may be used to add succulence to the ration we may mention apples, and other fruit, artichokes, sugar beet and other beets, cabbage, carrots, mangels, potatoes, pumpkins, turnips, silage, soiling crops and pasture. In general, these may be grouped into roots and fruits, soiling crops and pasture.

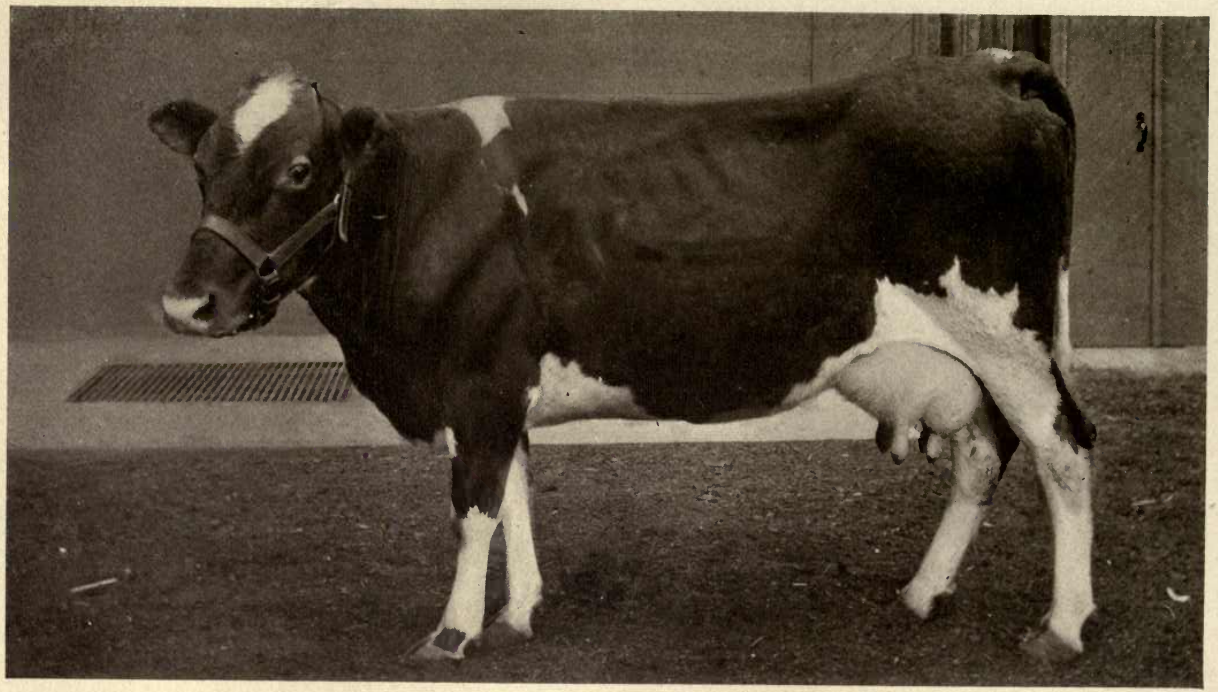
Apples and other fruits are sometimes fed in considerable quantities to dairy cows when the fruit is unusually cheap or injured by bruises. Windfalls are used quite extensively for this purpose. In Vermont, apple pomace has been studied very carefully as a feed for dairy cows and has been found to produce more milk and butter than immature corn silage. The butter was not injuriously affected in any way when apple pomace was fed in rations of thirty-three pounds per day. Likewise with pumpkins, all dairymen understand the digestive value of that feed. In fact, on many farms pumpkins are raised for little else than for feeding dairy cows or pigs. They may be fed in rations as high as forty or more pounds per day, but naturally should not be depended upon for affording much nutriment. In some tests where pumpkins were added to the ration it has been found that six per cent.

more milk and butter was obtained than when pumpkins were omitted. Sugar beets and sugar beet pulp, especially the latter, have recently come to occupy an extremely important place in the dietary of the milch cow. This material has been fed throughout the sugar beet belt and in many instances the pulp has been shipped long distances and has still been fed with profit. It is sold at all sugar factories at from fifty cents to $2.50 per ton and in many instances has proved to have a feeding value considerably higher than its market price. Sugar beet pulp may be fed in an almost unlimited ration, for example from twenty to one hundred pounds per day, but as a rule about twenty-five or thirty pounds give the best results. Sugar beets should be fed in smaller quantities, about ten to twenty pounds per day. Recently it has been found that dried beet pulp and dried molasses beet pulp may be advantageously used as food for milch cows in localities where the fresh beet pulp cannot be easily obtained. As is well known, sugar beet pulp undergoes injurious fermentation easily, and therefore, especially in summer, cannot be kept in good condition excepting for a short time. The use of dried pulp in New Jersey has given excellent results.

COARSE FODDERS

Alfalfa.—As may be gathered from the above discussion, leguminous forage plants are the most valuable of all coarse fodders for milk production. At the head of the list in this respect stands alfalfa, which is the chief leguminous crop throughout the arid and semi-arid West and is rapidly coming into more and more prominence in the eastern

and southern states. Alfalfa may be fed in the form of hay, as a soiling crop, or may be easily ensiled in the field by stacking and packing down tightly in a fresh condition. In Kansas, it was found that cows would eat as much as forty-five pounds of alfalfa hay per day, but that better results were obtained when the amount was reduced to fifteen or thirty pounds with a suitable grain ration in addition. With alfalfa, cows require less grain than with cereal hays, but on account of the great effectiveness of corn when properly balanced, a combination of alfalfa and corn meal gives one of the most profitable milk-producing feeds which can be procured at the same expense. In fact, there is hardly any combination which can equal alfalfa and corn, either for milk production or for making meat. When compared with silage, alfalfa is superior in milk production and is far more effective than any form of wild, cereal or meadow hay. Careful tests of alfalfa in New Jersey show that on an average about $67 worth of milk can be produced from the alfalfa from one acre of ground. Under favorable conditions, a considerably higher yield than this was obtained. In Tennessee it has been found that alfalfa hay can be safely and economically substituted for a considerable proportion of the grain in the ration for dairy cows. When used for this purpose it is slightly less effective than cowpea hay and either of these kinds of hay may be used to replace a considerable part of the bran or other grain fed in the cow ration, allowing one and a half pounds of alfalfa hay for each pound of wheat bran. Estimating the value of alfalfa hay at $10 per ton, and wheat bran at $20 a ton, it gives a cost of twenty cents less for every one



Courtesy of University of Wisconsin, College of Agriculture.

A HIGH-GRADE GUERNSEY COW—A GREAT BUTTER MAKER.

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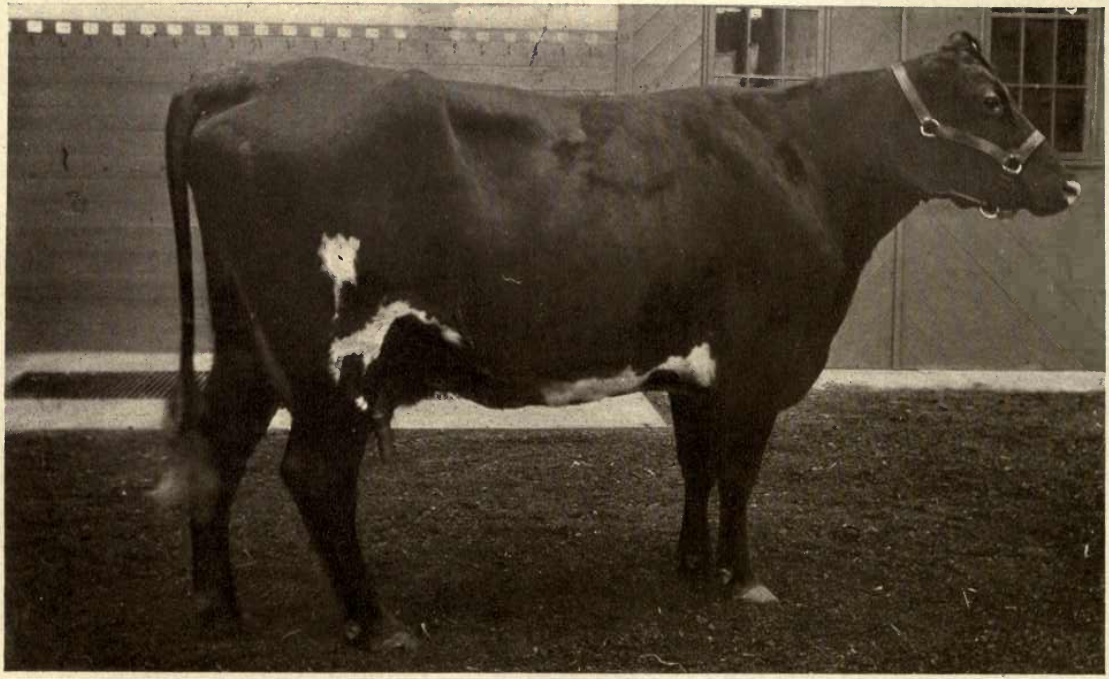


Courtesy of University of Wisconsin, College of Agriculture.

A HIGH-GRADE MILKING SHORTHORN.

hundred pounds of milk when alfalfa hay is substituted for wheat bran.

One of the most important items of economy in the production of milk is, therefore, the substitution wherever possible of home grown crops in the form of leguminous forage plants for high-priced purchased grain foods. As already indicated, alfalfa is not the only valuable leguminous forage plant, but red, white and crimson clover, cowpeas, vetches, soy-beans, velvet beans, Canada field peas, etc., may be used for this purpose.

Cornstalks.—The corn plant, exclusive of the grain, is universally recognized as an important coarse fodder for all animals which require such material. Since dairy cows can utilize more coarse forage than any other animal this material has come to fill a large place in the dietary of the dairy cow. The corn plant may be fed in the form of corn shives, pulled leaves, corn stover, corn fodder, or silage. If fed in a dried form, field cured, or stacked in barns, corn fodder should occupy about the same place as hay in the ration and should be supplemented by some succulent material such as corn silage or roots. The relative expense of harvesting, storing and feeding corn in the various forms has been carefully studied by a number of the agricultural experiment stations and it appears that, while the evidence in the case may vary according to the price of labor or other factors, it is usually more economical to harvest the corn just as the dent begins to show and ensile it, ears and all, and feed as silage. The difference in cost is not great, but is sufficient to make it desirable to recommend this manner of caring for corn for dairy cows wherever the conveniences are at hand for the production of silage.

In feeding meadow hay, timothy and other similar hays, it should be remembered that the nutritive value is much lower than the legumes and that this material is also inferior to corn stover. It is necessary, therefore, to use, in connection with such hays, a large amount of nitrogenous grain feed. As already indicated it seems to add to the effectiveness of the ration if some hay is mixed with the silage ration. Thus in Maine it was found that twenty-five pounds of silage, thirteen pounds of hay and eight pounds of grain gave better results in milk yield than when the hay ration was reduced one-half.

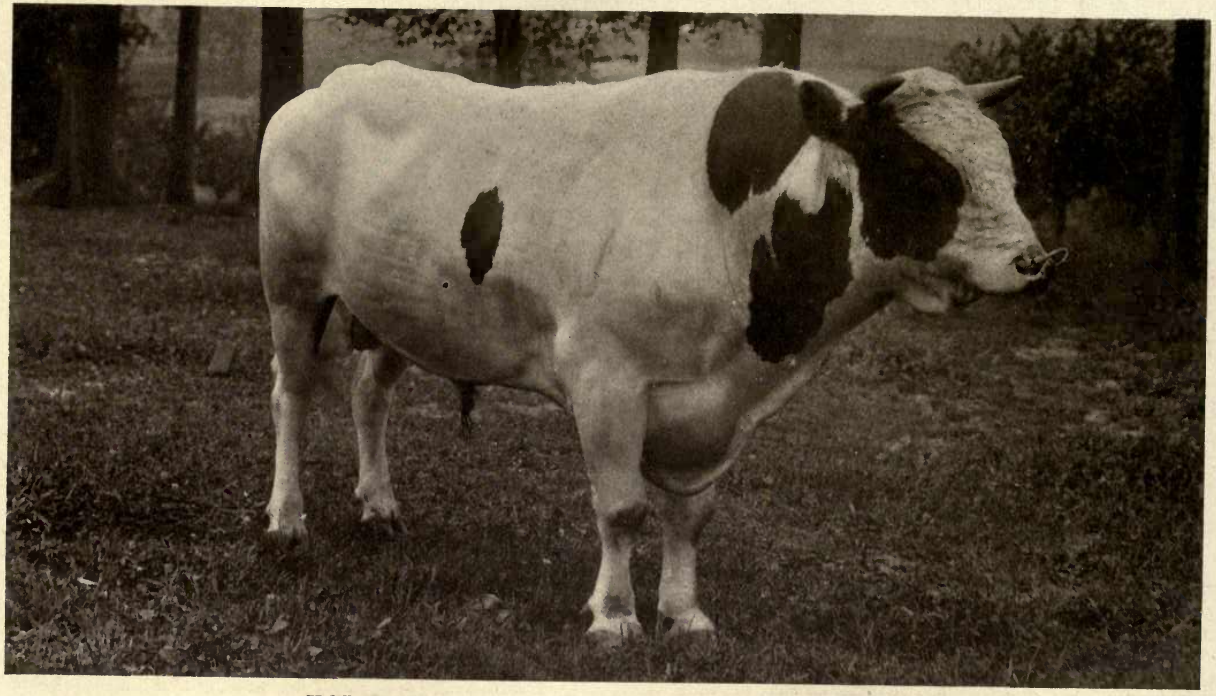
Soiling.—The importance of using soiling crops in dairy farming must be obvious even upon the slightest consideration. In the vicinity of large cities, where land values are high and where a crowded population renders it impossible to use large areas as pasture or for the production of single crops, it has been found possible to raise much larger yields of milk-producing material in the form of soiling crops than by any other means. In the various systems of soiling which have been adopted by the agricultural experiment stations which have taken the matter up, a number of schemes have been devised by which, through a suitable rotation, an abundance of green material may be obtained from May to November in the latitude of New Jersey. In a system of rotation it is necessary to use a number of different crops such as rye, crimson clover, oats, peas, soy-beans, wheat, cowpeas, millet, corn, barley, sorghum. As compared with pasture, it has been found that three to five times as much material can be obtained from an acre of ground by the soiling system as from pasturing. By the system of soiling, various

plants raised on the land devoted to this purpose are cut before becoming mature and are fed immediately in a perfectly fresh condition to the cows. The material is thus presented to them in the most succulent and palatable form in which it can be obtained and this, as is well known, has a great deal to do in determining the effectiveness of foods in the production of milk. In all localities where alfalfa can be cultivated successfully this should constitute part of the soiling system. Alfalfa may be cut from three to five times annually and the area devoted to this crop may be allowed to remain in alfalfa for eight or ten years while neighboring plots may be plowed frequently as required and planted to other crops to continue a proper system of rotation. In Wisconsin, excellent results in soiling have been obtained in the use of fall rye, alfalfa, red clover, oats, peas, flint corn, sorghum, sweet corn and other forage plants.

Pasture is a term which means various things, according to the system of dairy farming practiced by the individual dairyman. It may mean the familiar old fields allowed to remain in native grasses year after year without any attempt at improvement by way of cultivation or in introducing other and better forage plants. On the other hand, pasture may mean the most succulent and nutritious crops of alfalfa, cowpeas, clovers, vetches, oats, Canada field peas, wheat, rye, corn and other crops used particularly in increasing the milk yield. Obviously the amount of forage produced by native grasses without any assistance from man is exceedingly small. If the price of land is high it is bad economy to allow the soil to remain in that condition, since from

ten to one hundred times as much material can be obtained from the land by a suitable system of rotation. Not only is the amount of forage increased, but it is in better condition on account of being in a more active stage of growth than is the case with native grasses, which begin to turn brown and dry up in late summer and, therefore, do not tend to keep up the milk flow. Successful dairying, where suitable land is at hand for pasturing, depends to a very large extent on the proper management of such land for the production of large amounts of succulent forage. As already indicated, a great variety of forage plants may be pastured, but the most nutritious of these and the most effective in making milk are the legumes. Some of the cereals like winter rye and winter wheat may be depended upon to produce a very early growth of green forage and are, therefore, of great value for that purpose. Pasture, however, does not compare favorably in the amount of forage produced with soiling since the animals tramp down and soil or destroy a certain amount of the forage in pasture, even under the best possible conditions. In the southern states the utilization of pasture may extend over a much longer period than in the North, where the growing season is relatively much shorter.

In the western states a large number of native prairie grasses have been found very effective in producing milk. Orchard grass, English blue grass, red clover, and brome grass make a large milk flow under ordinary conditions. Moreover, brome grass withstands dry weather quite successfully and is, therefore, indicated in regions where a summer drouth prevails. Green wheat and



HOLSTEIN BULL—THE LARGEST DAIRY BREED.

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HOLSTEINS — HEAVY MILKERS, WITH DISTINCT BLACK AND WHITE PATCHES.

cereals have been found to give striking milk yields in Kansas and other states in the central west. A test of various pasture and soiling crops in Nebraska showed conclusively that cowpeas were capable of producing a greater quantity of milk and of butter fat from the same area than any other crop which has been tested in that state. Similar favorable results have been obtained from the use of cowpea pasture in Alabama and other southern states. Corn is likewise frequently planted to be eaten by cows in a young, fresh condition as pasture. In addition to the various crops already mentioned as pasture crops, millet has frequently given satisfactory results.

However luxuriant, succulent and nutritious pasture may be, it is always necessary to feed some grain to dairy cows on pasture, if the greatest possible milk flow is to be obtained. The amount of grain is much smaller on leguminous pasture than on pasture land bearing other less nutritious crops. In fact, if a leguminous pasture such as alfalfa and cowpeas is in excellent condition the flow of milk is quite satisfactory without grain. In nearly all cases, however, where the matter has been tested, the flow has been somewhat increased even on such pasture by the use of bran, cotton seed meal or corn meal.

Silage.—Throughout the dairy region of the United States silage is one of the important feeding stuffs for dairy cows. Its great advantage consists not alone in its succulence, palatability, and effectiveness in producing milk, but in the fact that it is so easily preserved during the winter, thus furnishing succulent material during the whole season when no growth is taking place out-

side and also, in the fact, that the expense of harvesting and preserving the crop in the form of silage is by no means a serious one. In fact, as the result of hundreds of experiments to test the economy of harvesting corn in various ways it has been demonstrated that the most economic one consists in ensiling the plant, ears and all, and feeding in this form to cows. More silage is fed to dairy cows than to any other class of animal, although it is a valuable food for all farm animals. In numerous experiments it has been found that corn silage is the most economical succulent food available for dairy cows at a season when pasture cannot be obtained. It is, of course, not a balanced ration, but it tends to a heavy milk production, especially when fed in connection with a leguminous hay. Moreover, silage can be fed not only during the winter, but also during the summer, particularly if the pasture should run short or become dry on account of the prevalence of drouth. Corn is, of course, the chief silage, and in most instances is the only plant concerned when silage is spoken of. It may, however, be combined in the silo with cowpeas or soy-beans and when this has been done the feeding value of the mixture is greater than that of corn alone, ton for ton. If corn is to be preserved in the silo is should be harvested just as the kernels begin to glaze. It is then cut by machinery and tightly packed in the silo, using care to tramp down particularly the outside portion of the cut corn. The top of the mass of corn in the silo is usually covered with a layer of straw, but this does not seem to be absolutely necessary since a certain amount of the top is sure to decay anyhow and be unfit for food. In a series of

nearly four hundred tests in which the effect of silage on the flavor of the milk was studied, sixty per cent. were in favor of the silage. These tests, in addition to thousands of other practical tests of the matter on dairy farms, in almost every state in the Union, show that no injurious effects should be looked for in the milk from feeding silage. If silage is fed in liberal rations, for example thirty-five to sixty pounds per day, the amount of grain necessary to produce a maximum flow of milk may be somewhat reduced or, stated in another form, silage may be utilized to replace a portion of the grain which would otherwise be necessary for feeding dairy cows. This obviously means a saving in expense since the chief item of expense in feeding cows is the grain feeds, especially if these have to be purchased. Where silage is fed in addition to a leguminous hay a still further reduction in the amount of grain is possible and a still greater economy in the cost of feeding. One great advantage of silage, which cannot be lost from sight, is that it is palatable for nearly all cows. The slightly acid and fermented taste which good silage possesses seems to be exactly to the liking of nearly all cows and they will eat it in preference to almost any form of hay, even the best alfalfa hay when they are not acccustomed to the latter.

It should not be imagined that since corn is the chief crop used for silage that it is the only crop utilized in this way. Not only corn and various legumes are ensiled, but also cereal hays, roots, sugar beet pulp, sunflowers, and other farm crops. Certain farmers practice the stack system of ensiling leguminous crops and have obtained good results. This practice, however, seems not to have recommended itself very strongly to the

majority of farmers. The method consists merely in stacking alfalfa or clover in a perfectly fresh condition as soon as possible after it is cut and allowing the hay to ferment in the stack. A layer on the outside and top of the stack spoils as is the case in the silo, but otherwise the material keeps in good condition.

Disagreeable Flavors in Milk.—All milk users are familiar with the disagreeable flavors in milk, which are frequently observed, particularly in the spring and fall. A considerable number of plants are known to lend a bad taste to the milk when eaten in large quantities. One of the most familiar disagreeable flavors in milk is that of the wild onion, or garlic. This plant is widely distributed in the dairy region, and on account of the fact that it springs up somewhat in advance of pasture grasses, is frequently eaten by the cows with very bad effects in the flavor of the milk. Various other weeds, however, lend less striking and less specific flavors to the milk, but in some respects no less disagreeable. Thus, fenugreek is objectionable on this account as well as elder leaves and other strong smelling brush. A number of the common roots used in feeding cows transmit a characteristic odor to the milk, which disappears under proper aeration. Thus, turnips give a turnipy odor to the milk. If the turnips are fed shortly before milking the flavor is much more distinctly influenced. A peculiar fact in connection with the turnip odor is that it may not be noticed in the milk at the body temperature but appears when the milk is heated to a somewhat higher temperature.

Maintenance Ration.—It is obviously a difficult matter to determine just how much of her food

the cow uses to maintain herself in weight and condition and how much is transformed into milk. The proportion of the food used for maintenance has been estimated at from thirty to sixty per cent. It is not a matter of great importance for the average dairyman since for the greater part of the year the cow is giving milk and the dairyman is not concerned in the exact classification of the food according to its use by the cow. He knows by experience that certain rations are required to keep the cow in a good condition and sustain a profitable milk flow. Dry cows in winter may be kept in fairly good condition on wheat straw or other straw with the addition of wheat, corn or Kafir corn or other suitable grain. Where red clover or alfalfa hay is available this may constitute the maintenance ration without the addition of grain food.

Rations.—Suitable rations for dairy cows have been carefully worked out, based on the experience of actual dairymen and the tests of dairy experts, for every state in the Union. In order to give a specific instance of the range of these rations a few examples may be reproduced in this connection, but without recommending them for any particular state. Each ration which has been recommended by various dairymen for dairy cows will obviously be most applicable to that locality where the foods in question are most easily obtained. Thus an excellent milk flow may be maintained on any one of the following rations.

Alfalfa hay, twenty pounds; oat straw, five pounds; wheat bran, two and one-half pounds; shorts, two and one-half pounds; oats, five pounds; cotton seed meal, one and one-half pounds.

Corn silage, thirty pounds; clover hay, five pounds; corn fodder, three pounds; oat straw,

one pound; bran, five pounds; linseed meal, two pounds; cotton seed meal, two pounds.

Corn silage, 25 pounds; mixed hay, seven pounds bran, six pounds; cotton seed meal, two pounds.

Turnips, forty-five pounds; wheat chaff, seven pounds; silage, fifteen pounds; oats two and one-half pounds; pea meal, two and one-half pounds.

Alfalfa hay, thirty-five pounds; wheat bran, seven pounds; barley three pounds.

Prairie hay, twenty pounds; corn stover, ten pounds; corn meal, eight pounds; bran three pounds; linseed meal, one-half pound.

Timothy hay, ten pounds; clover hay, ten pounds; corn, eight pounds; oats, one and one-half pounds.

The amount of various foods which can safely and most economically be fed to dairy cows will obviously vary greatly in different parts of the country on account of the variation in the prevailing market value of different crops.

Influencing Milk by Means of the Ration.—It has long been the dream of the dairyman to be able to increase decidedly the amount of fat in the milk by means of suitable changes in the ration or by feeding certain materials which would increase the amount of fat secreted in the milk. This, however, has not been possible to any marked extent. In fact the belief of all dairy experts and the general statement on the subject has been that the amount of milk obtained depends partly on the individual cow but can be greatly influenced by the character of the food while the percentage of fat in the milk is purely an individual matter with the cow and not subject to influence by the kind of food in the ration or by any changes in the ration. As a rule all experiments carried on to

test this matter have brought forth evidence in support of this proposition. Certain changes in the composition of the milk may temporarily take place as the immediate results of a change in the ration. Thus it has been found that the milk flow is increased decidedly when the greatest increase in the nutriment in the ration is made. On the other hand the most rapid shrinkage of the milk flow usually occurs when a great reduction in the total amount of nutriment in the ration takes place. Usually changes in the ration which can be made with regard to the amount of protein in it have less effect on the quantity and character of the milk than changes in the total amount of nutrition in the ration. This means in simple words that the greater the food the greater the amount of milk, at least within the limits of the cow's capacity for transforming food into milk.

With regard to the possibility of increasing the fat content in milk it may be stated that this can only be done within narrow limits and as a rule only for short periods. The feeding of oils and foods containing an excessive fat content may produce a temporary increase in the amount of milk but this increase is not always in the form of pure butter fat. In fact the specific character of the oil of the food may pass through into the fat of the milk so that the milk is in a certain sense adulterated when it comes from the cow.

We may now discuss briefly a number of practical points concerning the feeding and management of cows. With regard to the water furnished cows the practice varies greatly, some men preferring to have the water constantly before the cows in individual troughs or otherwise supplied as directly as possible from the hydrant while other dairymen

have had better success in watering cows only at regular intervals during the day. In some direct tests of this matter cows that were driven into the yard for watering gave as large an amount of milk and kept themselves in as good condition as those which had constant access to water. In summer cows prefer cold water and in winter they like to have the chill taken from it. Whenever opportunity is given cows to choose between extremely cold and cool water in winter, they always prefer that from which the chill has been taken. It is not desirable however, to heat the water too much.

Bedding should always be furnished in a clean and comfortable form. In fact this matter appears to be far more important, according to recent experiments, than has usually been supposed Not only is a sufficient amount of clean bedding necessary for the comfort of the cow and therefore for the greatest production of milk but the bedding serves incidentally to absorb the liquid parts of the manure and thus make a great saving in its fertilizer value. The materials which may be used for bedding vary greatly. Thus farmers may utilize for this purpose spoiled hay, straw, corn stalks, chaff, sawdust and shavings. In general, however, any material which contains dust or which easily gives rise to dust by the trampling of the cows is objectionable. For this reason chaff, moldy or musty hay or straw are undesirable as compared with other materials such as corn, rye or wheat straw, sawdust and shavings. In the matter of cost shavings are ten times as expensive as sawdust, being about on a par with cut or uncut wheat straw and cut corn fodder. Recent experiments carried out at the Maryland Experiment Station show that the yearly cost for stabling cows 24

hours per day is forty-five cents with sawdust, and $4.80 for shavings or cut wheat straw. Sawdust was found to absorb a much greater amount of the liquid manure than any of the compared materials. Moreover sawdust adds to the bulk of the manure and to the ease with which it may be spread upon the land. Cleanness and a wholesome appearance of the cow stables are secured by the use of sawdust and in this respect no other material can compare with it excepting perhaps shavings and these are always too expensive as compared with sawdust. It is obvious therefore that if a saw mill is located conveniently for the dairyman it is desirable to haul this material for use as bedding in order to benefit from the increased cleanliness and appearance which can thus be obtained in the stable.

The Age of the Cow as Related to the Milk Yield.—Good dairy cows usually give an increasing yield of milk up to the age of seven years or more after which the milk yield remains nearly stationary up to the age of ten or twelve when it begins to decline quite rapidly. As a rule the quality of the milk decreases as the cow advances in age. In one series of tests the average fat content was, for the first year of lactation, 4.49 per cent., for the second 4.4 per cent., for the third 4.29 and for the fourth 4.17 per cent. Similarly during any single period of lactation the amount of milk decreases during the period and also the production of milk fat. As a rule the yield of milk decreases about eight per cent. for each month while the amount of butter fat decreases about seven per cent. It may be stated that the milk yield is greatest in the second and third weeks of lactation.

A lively rivalry naturally exists regarding the

relative merits of the different breeds of dairy cows, and these claims have often led to comparisons in the yields of milk, which may be expected from the different breeds. According to most tests which have thus far been made, the Holstein gives the greatest amount of milk, but of a low fat content. In tests in Wisconsin for the relative yields of different breeds the Holstein was followed by the Brown Swiss, Shorthorn, Guernsey, Ayrshire, Dutch Belted, French Canadian, Red Poll, Jersey and Devon. With regard to the fat content of milk, Jerseys and Guernseys stand close together at the top followed by Devons, French Canadian, Ayrshires, Red Poll, and Shorthorn. In the matter of the cost of production of milk, the Guernseys and Ayrshires stand at the head of the list in most tests. Thus, in one set of experiments in New Jersey, the different breeds stood in the following order with regard to the cost of milk fat: Guernsey, Jersey, Ayrshire, Shorthorn, and Holstein. In the relative profit derived from milk the usual order in which the breeds have stood in actual experiments is Holstein, Shorthorn, Ayrshire, Guernsey, Jersey and Devon. Tests have also been made regarding the relative profits of different breeds for cheese production, but this is not of great value since, as a rule, a good cheese cow is also a good butter cow. While in all of these tests the influence of the food on the quality of the milk has been noted carefully, it has been found in corroboration of what was said before on this point that in general the food of the cow influences the fat content in the milk very slightly or merely to the extent that the cow yields the greatest amount of milk with the highest fat content on rations which are relatively high in protein.

It is interesting to note the sources of the fat in milk, and numerous experiments have been with this definite idea in view. From these experiments, it appears that a part of the milk fat comes from the sugars and starches in the food. The cow has the power of manufacturing milk fat not only from the fat of the food, but from the carbo-hydrates. In one experiment, in which, for a period of two months, the cow was fed a ration as free from fat as it was possible to obtain it, the cow produced eighteen and one-half pounds of milk fat, which was not present in the food in any other form than starch or sugar. During this time the cow gained in weight so that the fat could not have been obtained from the body fat of the animal. Evidently, therefore, the cow is able to transform the starch and sugar in her food into milk fat.

At Cornell University an interesting and carefully planned experiment was carried out to test the general problem regarding the possibility of improving the quality of the milk through the ration. The experiment was continued for two years. It appeared as a result of this work that the quality of the milk can be influenced to an appreciable extent by giving attention to the composition of the ration. Thus, in the case in question, an abundant ration of easily digestible and nitrogenous foods resulted in an increase of one-fourth of one per cent. in the milk fat. At the same time the quantity of the milk was increased about fifty per cent., so that the very slight increase in the fat content becomes of considerable importance in view of the largely increased amount of milk from which the fat could be removed. The rations used in this experiment contained such foods as are readily accessible to all farmers, and

the only point worth mentioning in connection with them was that all the rations were compounded with reference to the quality of the food so as to give a suitable balance.

In addition to the food, various other things exercise a greater or less effect upon the milk yield. Thus, in sudden changes of weather unfavorable results may be experienced in the diminution of the amount of milk obtained. The dairy cow is rather a nervous creature and responds quickly to these changes. It is desirable from a financial standpoint, if no other consideration appeals to the farmer, to protect the cows against inclement weather, especially cold rains. Muddy sheds, insufficient amount of bedding, excessive attacks of flies, worry from dogs and from the presence of strange attendants, any of these immediately influence unfavorably the amount of milk obtained.

The question is often brought before the farmer regarding the forms in which he may most profitably dispose of his dairy products whether as milk, cream, or butter. As a rule, a greater profit is obtained for the milk as such or for cream than can be secured in the form of butter. Thus, if the farmer can obtain from seventeen to nineteen cents per gallon for milk and seventy cents per gallon for cream, as is usually the case, the milk fat would have to be paid for at the rate of forty cents and the butter would have to sell for thirty-three cents a pound in order to realize the same amount for the milk. Creameries, however, almost never pay that much for milk fat, and farm butter cannot be sold for an average price of thirty-three cents a pound. The result is that for most farmers, the greatest profit is to be derived from selling the milk or cream. Professional dairymen keep an

account of the cost and the profits in the case of all of their cows. This should be brought to the notice of all persons intending to enter into the dairy business. The profits derived from dairy cows obviously depend upon the individuality of the cow and the kind of treatment she receives. As the result of a test of ordinary farm cows in various states throughout the country, the surprising fact has been disclosed that in nearly all dairy herds there are cows which do not give enough milk to pay for their keep. Where such cows are kept for dairy purposes it simply means that the milk is not weighed nor tested for milk fat and that, therefore, the owner has no means of knowing whether the cow is yielding an average amount of milk or not. The results obtained by this test furnish striking arguments for the necessity of frequently testing the milk of all cows to determine the yield and percentage of milk fat. When this has been done it is an easy matter to eliminate the unprofitable cows from the herd and fatten them for beef, replacing them with other dairy cows.

From records obtained in creameries in Missouri it appears that the average returns from cows in that state amount to from $37 to $61. The value of the milk sold at the creamery may be estimated at from $50 to $60 per cow, the value of the cream and the milk returned and fed to calves and other domestic animals is about $10 per cow and the value of the calf for veal about $4. This makes the average financial production of each cow range from $64 to $74 per year.

It must always be borne in mind, however, as shown by almost innumerable tests for milk fat and milk yield, that there are enormous differences in the profit to be derived from individual dairy

cows. A striking illustration of this is seen in the fact that a number of cows have yielded from five hundred to eight hundred pounds of butter per year and one Guernsey cow in Wisconsin even one thousand pounds in a year, while the average yield may be set down as two hundred and fifty pounds of butter. It is apparent, therefore, that one cow may produce four times as much as another during one period of lactation. A cow with a high milk yield does not necessarily eat much more than an unprofitable cow. At any rate, the difference in the amount eaten is so small as scarcely to affect the relative profit from the cow. Moreover, as already indicated, there are thousands of cows kept for dairy purposes which do not produce more than one hundred pounds of butter per year. Such poor milkers cannot be kept at a profit and are less valuable for milk than for beef. Different cows vary greatly, not only in the amount of milk produced, but in the amount of food required to produce a pound of milk. Those cows which can transform feed into milk most economically are obviously the most profitable cows, since the greatest expense in connection with dairying is the providing of food.

Reference has already been made to flies as a source of annoyance to cows. There are many species of flies which attack cows, but the horn fly and the common stable fly are most injurious and are distributed over the greater part of the dairy region. In some localities it has been found necessary during the worst part of the summer to keep the cows in cool barns during the heat of the day, with the windows carefully screened to keep the flies out. The cows are then allowed to graze on pasture at night. Numerous remedies have

been tried for driving flies away from cows and for exterminating them in the vicinity of stables. In Kansas the best results have been had from spraying cows with a mixture containing one-half pound of resin, two cakes of laundry soap, one-half pint of fish oil and enough water to make three gallons. The effectiveness of this mixture is somewhat increased by adding one-half pint of kerosene. This insecticide costs about seven or eight cents per gallon and one half pint is enough for one application for a cow. At the height of the fly season it may be necessary to give three applications a week. The general question of flies in the dairy has been studied in Connecticut, where it was found that the annoyance caused by flies appears to have been somewhat overestimated. In Connecticut, as in Kansas, the most attention was given to horn flies and stable flies, and numerous remedies were tested on the recommendation of those who had tried them in Connecticut, Wisconsin and other dairy states. These remedies included many proprietary ones, all of which appeared to be reasonably effective although somewhat expensive. In Virginia the application of ordinary kerosene emulsion to cows during the season when they were badly attacked by horn flies was found to be most effective and the cheapest remedy of all those which could be easily applied to cows.

Methods of Milking.—It is a well-known fact that the first streams of milk that come from the cow contain a very low percentage of fat, one per cent. or even less, while the strippings may contain as high as twelve per cent. of milk fat. This fact shows how important it is to secure all of the milk which has been secreted at each milking. In order to do this a number of practical schemes have

been devised which may be described as consisting simply of thorough stripping at the end of each milking period. Recently considerable interest has been awakened in a new method of milking recommended by a Danish dairy expert, Dr. J. Hegelund. The method is accordingly known by his name. This method of milking has been tested throughout the country and somewhat contradictory reports have been given out concerning it. The Hegelund method may be described as follows: The right quarters of the udder are pressed together by the two hands, the thumbs being held on the outside of the udder and the index fingers in the division between the two halves of the right side. In producing pressure by the hands a slight upward motion is also given to the udder. This motion is repeated three or four times after which all of the milk in the milk cistern is removed and the manipulation is repeated, the same treatment being, of course, given to the right and left sides. Following upon this, the two front quarters and the hind quarters are treated similarly, and finally the teats of the four quarters are manipulated so as to secure all the milk which has been secreted at the time of milking. In a dairy herd kept at the Wisconsin University, the yield of milk was increased four and five-tenths per cent. by means of the Hegelund method and the production of fat was increased from three to thirty per cent. with an average of nine and two-tenths per cent. The large increase in the milk fat obtained is obviously due to the fact that by this method the rich milk yielded at the end of the milking period is obtained more completely than by the ordinary method of milking. This increase in the yield and in the fat percentage was maintained throughout

a period of four months, and it is estimated that if this method of milking were adopted by all dairymen throughout the state of Wisconsin there would be an annual gain of thirty million pounds of butter fat.

Shelter.—A great difference of opinion prevails regarding the question of the proper amount of shelter to be furnished dairy cows, especially during the winter. Some dairymen recommend that cows should be protected against cold temperatures during the winter season, even to the extent of furnishing artificial heat for the stable if necessary to secure the best results. In fact the statement has been made that a high temperature is more necessary in the cow stable than proper ventilation or arrangements for the escape of odors and of animal substances excreted by the lungs. By no means all dairymen, however, follow this practice and the opposite statement is frequently met with, viz.: that dairy cows do not endure confinement and yield more milk and keep in better health when allowed a reasonable amount of outdoor freedom even during the coldest weather of winter. In order to obtain data regarding the common practice of dairymen in this respect, the Experiment Station in Illinois sent out circular letters to the most prominent dairymen of the state asking for a direct answer to the question regarding the comparative merits of freedom for cows versus stabling. Nearly all the dairymen replied to this series of questions that the cows kept cleaner when allowed to remain in the open shed for a considerable portion of the day and furthermore that the milk stable may be kept in a more sanitary condition and that cleaner milk is, therefore, produced, and that the cows do not worry or injure one

another so much in the open sheds as when confined in stanchions. There seems, therefore, to be a general belief among dairymen who have tried this outdoor method of keeping dairy cows that great advantages are thereby to be derived, the chief being as already stated, clean stables, cleaner cows, cleaner milk, better health in the cows and an increase in the amount of manure obtained since a relatively large amount of bedding must be used in the open sheds in order to keep the cows perfectly clean. As a result of the prevalence of this practice of allowing dairy cows outdoor freedom in winter, the Illinois Experiment Station conducted a careful experiment with this end in view. The results of this experiment showed that the cows kept much cleaner than when stabled, that the milk stable was in a more sanitary condition and, therefore, that it was much easier to produce clean milk. The cows showed better health and better appetite than when kept in the stable and the saving of labor was quite striking. It is well perhaps to call attention to the great importance of this economy of labor since at present one of the most serious questions on dairy farms is that of getting sufficient qualified labor to take care of the cows. Where cows are kept in the stable continuously, it is obvious that unusual attention must be given to their surroundings in order to make them comfortable. It appears to be an unnatural practice to keep dairy cows tied up in stanchions for six months of the year, as is too frequently practiced among dairymen. In such cases the feed and water are brought to the cows without their being allowed to have any exercise, and this lack of exercise appears to be a sufficient cause for the loss of vigor and a shortening of the life of usefulness of dairy

cows. The Wisconsin Dairy School suggests the following daily schedule for the care of cows: 4.20 a.m. grain fed; 4.30 a.m. milked; 6 a.m. silage fed; 7.30 a.m. stables cleaned; 8.30 a.m. water; 9.00 a.m. hay; 10.00 a.m. grooming of cows; 2.00 p.m. cows turned out; 3.30 p.m. watered; 4.00 p.m. stables cleaned, and corn fed; 4.30 p.m. milked; 6.00 p.m. silage fed; 8 p.m. bedding arranged for the night.

Dehorning Cows.—It is, of course, best and most humane to dehorn calves when only a few days old as described in the chapter on beef cattle, but if this operation has been omitted it is desirable to remove the horns by means of a clipper in order to prevent the cows from worrying one another. Every one who has worked with cows knows that in every herd there is one or perhaps more cows which attempt to hector the rest of the herd, the result being a loss of milk and frequently more or less serious injury. The dehorning of adult cows should preferably be done at a time when they are dry rather than during the height of the milk flow. Experiments in dehorning cows in full flow of milk show that the milk yield may be diminished nearly fifty per cent. for the first two or three days and it may be a serious matter for a week or so.

Dirt in Milk.—The purpose of keeping dairy cows is not simply to produce milk, but to produce clean milk. In order to obtain clean milk no devices or methods can be included which tend in any way to an unsanitary condition of the milk. When cows are kept in the stable for a part of each day, it is quite unavoidable that they should become more or less contaminated with dust and animal filth. This material, if not carefully

brushed from the cows before milking, falls into the milk in large quantities at milking time and thus contaminates the milk not only in the way of the filth introduced, but by the numerous bacteria carried on this dirt. It is practically impossible under ordinary dairy conditions to prevent some dirt from falling into the milk. By careful grooming and washing of the teats and milking with dry hands, however, the amount of dirt may be reduced to a minimum. Experiments have shown, with cows kept in an ordinary condition, but not groomed, that during the process of milking one ounce of dirt is added to each two hundred and seventy-five pounds of milk.

The presence of dirt in milk is always an evidence of unsanitary conditions or methods on the part of the dairyman. The mere presence of filth, however, may not be injurious in any way in itself. Filth in milk is always associated with an increase in the number of bacteria in the milk and this is a much more serious proposition, for a greater number of bacteria in milk sour the milk quickly and are likely to produce colic and other digestive disturbances in children and to a less extent in adults.

Milk as it is secreted in the actual glandular tissue contains no bacteria. Many bacteria, however, succeed in penetrating into the milk duct of the teats and, therefore, the milk in the milk cisterns contains some bacteria. Milk is one of the best of nutritive media for the growth of bacteria and, therefore, their numbers multiply with astounding rapidity. Moreover the number of bacteria in milk is suddenly added to from other sources such as the air, cow's skin, the

hands and clothes of milkers, and unsanitary milking utensils. Thus, from actual tests, a sample of milk which contained one hundred and fifty-three thousand bacteria per cubic inch when examined first, contained five hundred and forty thousand per cubic inch after one hour, one million after seven hours, and eighty-five million after twenty-four hours. If the bacteria in the milk are not particularly harmful ones which do not produce any disease, the milk is not greatly to be feared, except in view of the fact that it may produce slight digestive disturbances. Where, however, the cow is affected with tuberculosis or garget or where the milkers are affected with scarlet fever, diphtheria, typhoid fever, or tuberculosis or come in contact with persons suffering with these diseases, the question of milk supply becomes a very serious one. In hundreds of instances milk has thus become the agent for the carrying of typhoid, scarlet fever, diphtheria, and tuberculosis to children and adults. The milk of tuberculous cows is always dangerous as human food and that from cows suffering from garget is not only highly repulsive on account of the fact that it contains actual pus, but it is dangerous on account of the fact that it produces serious cases of diphtheritic sore throat or other throat troubles. In marketing milk, it is necessary to adopt some standard of excellence, and dairymen who desire to furnish a wholesome product naturally bear these facts in mind. Pure milk from a bacteriological standpoint should contain less than ten thousand bacteria per cubic centimeter and must be absolutely free from disease germs and pus. The actual number of bacteria found in samples of

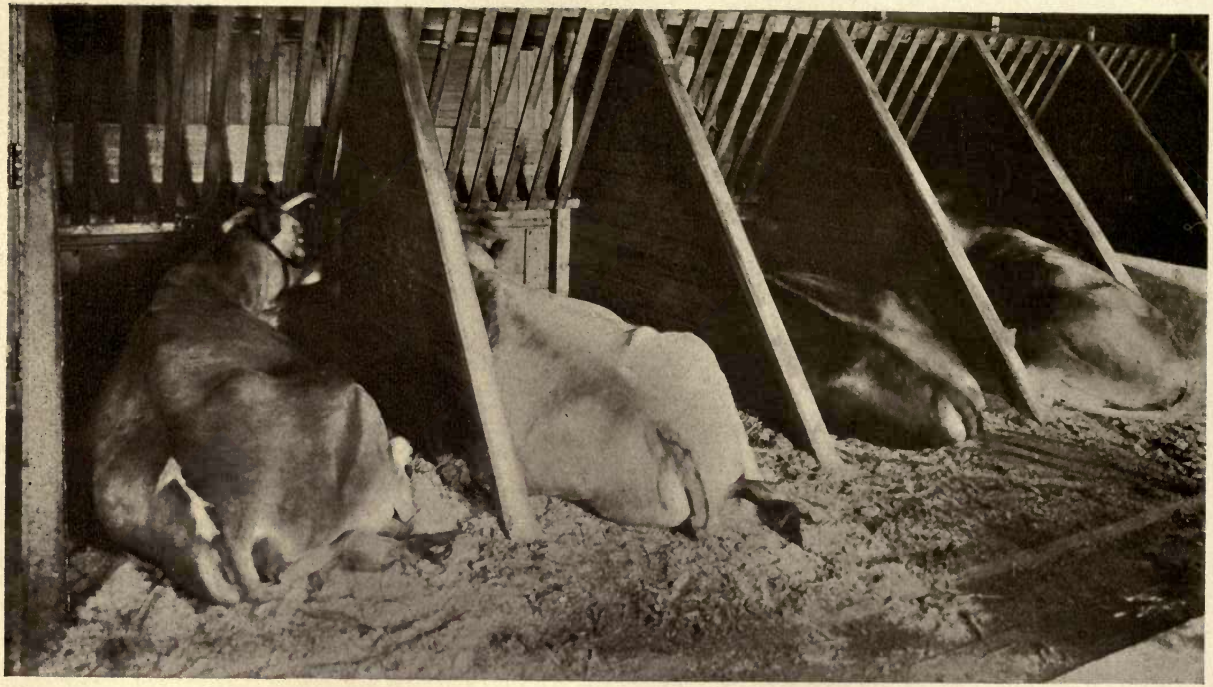
market milk varies from twenty-five thousand to ten million per cubic centimeter. The presence of fifty thousand bacteria per cubic centimeter does not indicate any serious neglect of sanitary precautions on the part of the dairyman, but much larger numbers are evidence of neglect on his part.

In order to practice sanitary dairying it is necessary to observe many precautions, some of which may be set down as follows: It is necessary to remove the milk at once from the stable, cool it down to a temperature at which bacteria do not readily grow and keep it under conditions where it cannot be affected by the presence of filth. It is not necessary to construct expensive stables, but the milk stable should not be directly connected with the hay or feed barn in such a way that dust from the latter may contaminate the milking stable. In order that this stable may be kept clean, the floors must be smoothly laid, preferably of dovetailed boards or still better of cement. All dairy utensils with which the milk comes in contact must be thoroughly sterilized by boiling water or steam after each using. The sanitary care of dairy utensils is a matter which often gets too little attention. It is not sufficient merely to wash the dairy utensil as other dishes are handled, but the utensils must be washed in all corners in order that no milk fat is left behind in them and every part of the utensil must be thoroughly sterilized with boiling water or steam, otherwise bacteria remain in connection with the fat from the milk and are in a position to cause a rapid souring of fresh milk when placed in such utensils. These requirements should apply with special force to the hand separator on the farm. This utensil has

recently come into unusual prominence throughout the country and thousands of them have been sold for home use in small dairy herds. It has been shown, however, by painful experience, that the butter made from milk separated by hand separators on ordinary farms is usually of inferior grade and this fact is partly due to the lack of attention in cleaning the separator. If the hand separator is not taken apart, thoroughly scoured, and sterilized after each using, it becomes simply an incubator for bacteria, and the milk which is subsequently run through it becomes immediately contaminated and rendered more or less unfit for use.

The Care of Milk.—As should be apparent from the previous discussion, milk is the most susceptible of all human foods to various changes which render it unsuitable for use either on account of bad odors, bad flavors, souring or other bacterial changes. The care of milk so as to prevent these undesirable happenings is, therefore, one of the most important parts of dairy science. In the present discussion, however, it is impossible to go into this in any detail and it is unnecessary to do so on account of the fact that the subject of practical dairying is really a technical one by itself and the average farmer is through with the dairy business as soon as the milk is produced. At any rate, he is chiefly interested in its production rather than its manufacture into a finished food product. One point in the care of milk which particularly concerns the farmer relates to its preservation in a wholesome condition until delivered to the creamery, or to patrons. He must also give heed to the preservation of skim milk for feeding to calves and to the proper ripening of cream for the manufacture of butter at home.

In order to secure sanitary market milk many plans have been devised, some of which have been put in operation in the different states. The conscientious dairyman who honestly desires to deliver sanitary milk to his patrons or to the city dealer will naturally be interested in observing all precautions which tend to the best preservation of milk. To this end a large number of factors contribute. In the first place, the stable should be arranged with a view to the comfort of the animal. Floors, gutters, walls and ceilings should be constructed so that they can be readily cleaned. Ventilation must be provided so that disagreeable odors will be rapidly carried away. The stable must be scrupulously cleaned at frequent intervals and, if at all possible, the milking stable is best separated from the feed barn for the reason that dust from hay and odors from other feeds are thus prevented from getting into the milk. The herd itself must be tested with tuberculin and known to be free from tuberculosis. All cows must be healthy in every respect. Particularly, they must be free from garget or any form of inflammation of the udder which can influence the appearance or condition of the milk. While not all animal diseases are transmitted to man, it is obviously dangerous to human health to sell milk from any cow suffering from a serious disease, especially if it is accompanied with high fever. The water supply should be carefully guarded and should not be drawn from close proximity to manure heaps, privies and other sources of contamination. The milkers must be cleanly in all their habits and of course be in health. It should be strictly forbidden that any one affected with a contagious disease, or living in the same room



COWS IN COMFORT AND CLEANLINESS.

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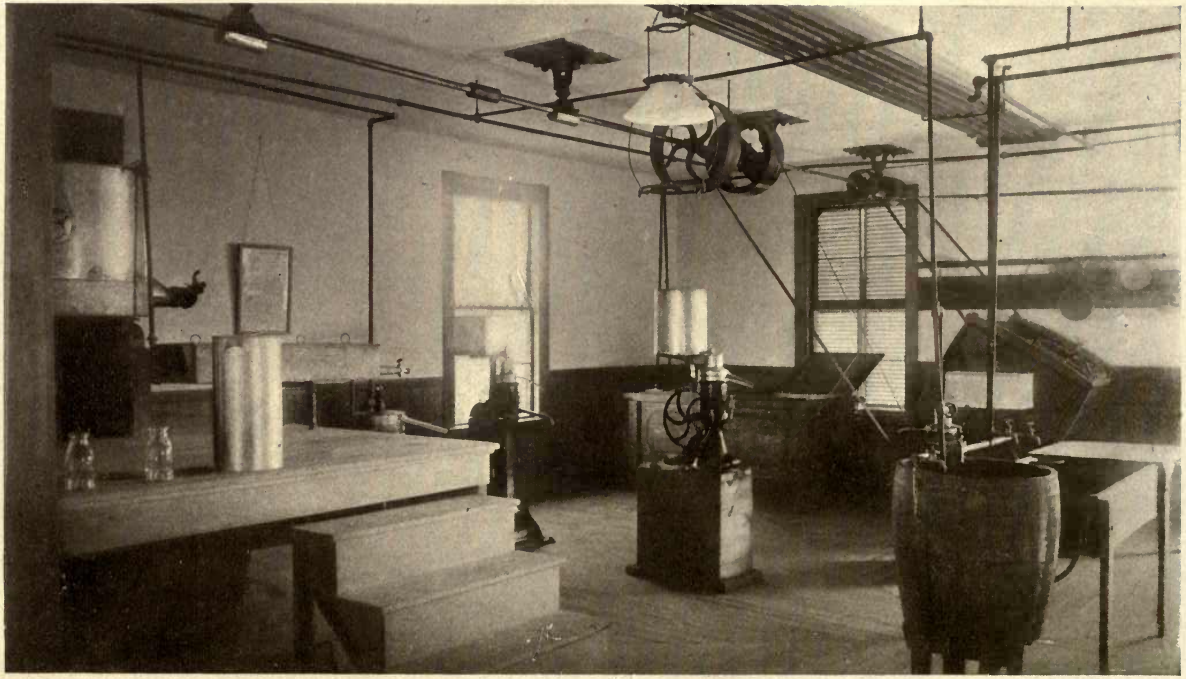


INTERIOR OF DAIRY ROOM WITH MODERN APPARATUS.

with another person affected with a contagious disease, should milk cows during such time as he is likely to carry infection. The cows should be thoroughly groomed before milking and the milkers' clothes and hands should also be free from filth.

In order to prevent fermentation and other bad effects which must necessarily arise from the filth and bacteria which get into milk even under the best conditions it is desirable to adopt certain other practices in order to make as little room as may be necessary for the development of such bad results. On this account milk should be strained and aerated immediately after milking. It must at once be removed from the milking stable and cooled down to a temperature of forty to sixty degrees F. On the farm it is often impracticable to cool milk to forty degrees F., but it keeps better if this temperature can easily be obtained. If the milk is to be run through a separator this process should take place while it is warm and fresh or, if that be impossible, and the milk is allowed to cool, it is best to warm it up again to a temperature of one hundred degrees F. or above, before running through the separator. If there is any question about the quality of the milk as regards bacteria, and particularly if any doubt exists regarding the fermentation of the milk from disease germs it should be pasteurized at a temperature which will destroy these organisms. This may be accomplished by heating the milk to a temperature of one hundred and forty degrees F. for about twenty minutes. Not all bacteria will be destroyed by this method, but the milk will be rendered practically safe for all purposes. If milk is cooked at the ordinary boiling temperature, the composition is slightly changed

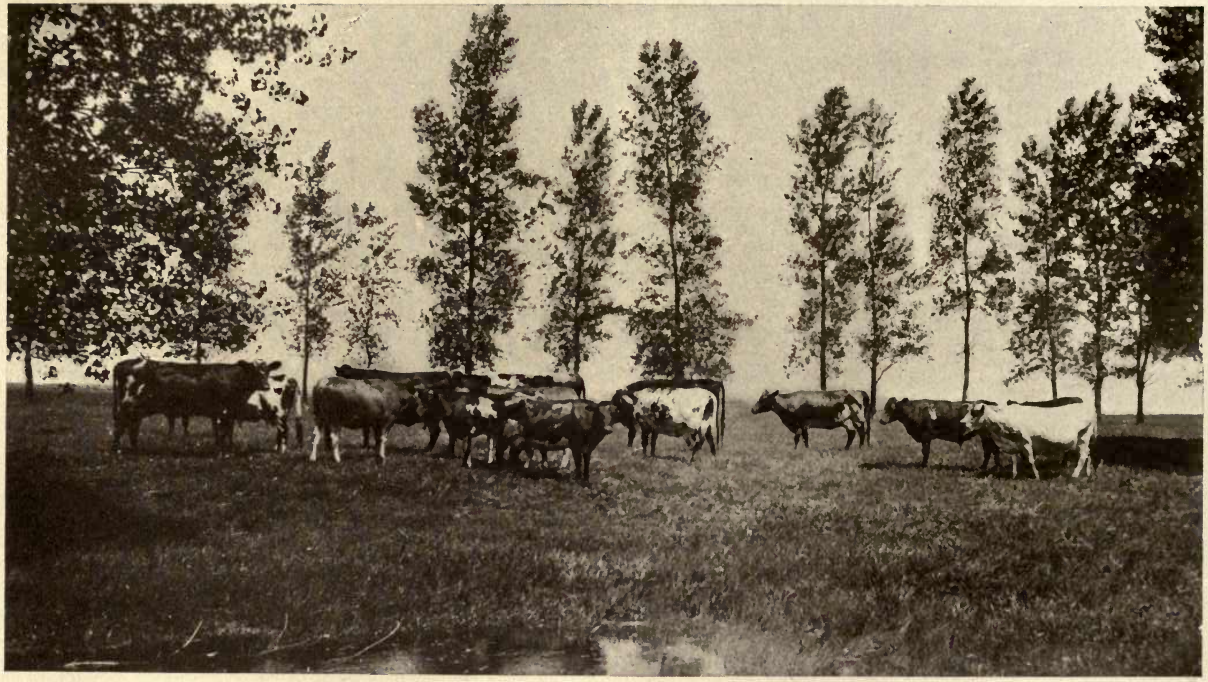
as well as the taste and it is, therefore, less desirable as a food for infants and has the peculiar cooked taste which is objectionable to many individuals. Without entering into the merits of these various schemes for securing the cleanliness of milk, it may be said that when sanitary methods have been adopted on farms where they were previously not practiced, the cleanliness and keeping quality of the milk have been greatly improved at an expense so slightly increased as to be almost negligible. In fact, it is everywhere well understood that a much larger price can be reasonably asked and readily obtained for a product which can be guaranteed to be clean and wholesome than for one about which any doubt exists. Milk and eggs are perhaps the two human foods about which it is necessary that no doubt should exist as to their quality. While milk is used almost universally as a human food the consumption of it would undoubtedly increase greatly if the quality of the ordinary market milk were better. Many persons hesitate to drink milk or use it in any form before it has been cooked on account of the fear of bacterial contamination or the presence of some other filth. If these objections to milk be removed by the observance of clean methods on the part of all farmers and dairymen, a greatly increased market for milk will be obtained and the benefit derived from such an increased consumption of milk would be equally shared by public at large and the farmer.

In discussing the methods of preserving milk, reference has been made only to those requiring cleanly habits and pasteurization. It is possible to prevent milk from souring by the addition of preservatives and a number of these have been used to a greater extent than is desirable. While a bitter

controversy still rages regarding the injurious effects of preservatives in food it would obviously be without point to enter into the discussion of the matter in this connection. However, no injustice is done any one in urging that, even if the use of preservatives be finally justified in the case of meat and other products destined for long keeping, this method does not apply to milk. Milk is obtained twice daily and can be delivered in a perfectly fresh condition to a distance of two or three hundred miles from surrounding towns by means of the fast milk trains, which are a special feature of the modern dairy business. It is, therefore, utterly unnecessary to attempt to preserve milk beyond the length of time it will keep if clean. The use of preservatives merely furnishes an excuse for the prevalence of filthy habits about the dairy. Perhaps the least objectionable of all of these preservatives is formalin which, when used in the proportion of one part to forty thousand, has the effect of checking the growth of bacteria and preventing the souring of milk much longer than would otherwise be the case. Even formalin, however, has been objected to by physicians on account of its injurious effects upon infants.

In comparing the relative power of the beef steer and the dairy cow to make products out of food, it was stated that the dairy cow makes ten times as much milk from the same amount of food as the steer does beef. This statement may be subject to great discount by reason of the fact that meat is considered to be a more solid food than milk. The percentage of water, however, in meat and milk is nearly the same and this fact makes the relative production of the dairy cows as compared with the steer even more marvelous. The average compo-

sition of milk as based on more than two hundred thousand samples is: water, eighty-seven and two-tenths per cent.; fat, three and nine-tenths per cent.; milk sugar, four and seventy-five hundredths per cent.; casein, three per cent.; albumen, four-tenths per cent.; ash, seventy-five hundredths per cent. The total solids in milk ranges from eleven to fifteen per cent. in different breeds and in individual cows. It is apparent, therefore, that the recognized great food value of milk rests on a substantial basis of chemical analysis.



DAIRY HERD AT PASTURE IN SOUTH DAKOTA.

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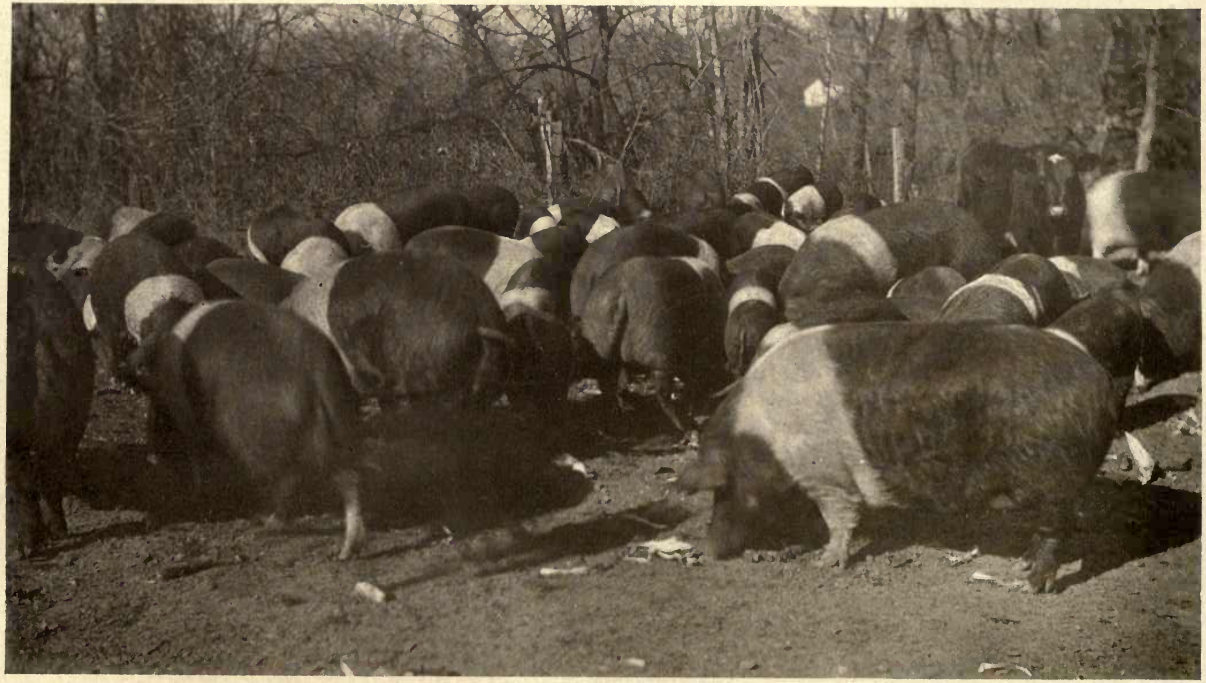


Photograph furnished by E. C. Stone.

HAMPSHIRE SWINE AT BREAKFAST.

CHAPTER V.

PIGS

For various reasons pigs are more profitable animals to raise than beef steers or sheep and on this account have always occupied a highly important place in the list of farm animals throughout the country. The unusual profitableness and economy in raising hogs are due to a number of facts. In the first place, the size of the litter is larger than of any other farm mammal. Thus litters of eight or ten are not rare, and sows which give birth to less than four or five pigs are considered unprofitable. On the other hand the birth of twins even in sheep and cows only occurs in a comparatively small percentage of cases, excepting in certain breeds of sheep. Moreover, hogs are ready for market at the age of ten months or, at any rate, under one year. This is also true to a limited extent of lambs raised for the winter market, but as a rule hogs compare very favorably with any other farm animal in the early age of maturity. Then, we must remember that hogs only require half as much food to make a pound of gain as is necessary for the production of a pound of beef. In this respect hogs also excel sheep, requiring only two-thirds as much food for a pound of pork as sheep consume in making a pound of mutton. Another point in favor of pork production, as compared with other lines of animal industry, is that the percentage of dressed weight is very high,

ranging from seventy-five to eighty-two per cent. or more. This is considerably better than either beef or mutton. Hogs are everywhere known to be useful in the transforming into pork of various waste products which are not much eaten by other farm animals. Again hogs are inexpensive animals to buy and the original cost of getting into the business of raising pork, is, therefore, very small as compared with that of beginning beef production. On acount of the rapid multiplication of these animals, a herd is readily built up from one or two sows and the foundation laid for a profitable pork producing industry.

At the present time the pork production in the United States is on a very fine basis. The profits to be derived from it have perhaps never been greater and the market at home and abroad is daily increasing. Fifty-six million, five hundred thousand hogs are annually slaughtered in the United States and of this number six million, five hundred thousand are exported, for the most part after curing. The average value of the pork carcass is $8.75. It may be added as a curious fact that statistics show that the number of hogs slaughtered annually is one hundred and ten per cent. of the total number kept on hand. This difference is readily explained by the fact that pigs are kept less than one year before slaughtering and the litters are very large. It is possible, therefore, to slaughter each year a larger number than are actually kept over and still maintain a tolerably constant or slightly increasing number of hogs in the whole country.

While, as already indicated, it is a comparatively inexpensive and simple matter to get started in pork raising it is, nevertheless, true that considerable

skill and intelligence must be exercised in this business as in other forms of animal industry. In fact the farmer cannot expect to obtain the best price for his pork unless the pork answers the market requirements in all respects. There are a number of market classes of hogs as there are market classes of beef steers and horses. The usual classes recognized are prime heavy hogs, butcher hogs, packing hogs, light hogs and pigs. Various other miscellaneous classes of more or less importance also occur. With regard to the weight required in these different market classes it should be stated that important changes have taken place in the fashionable sizes of hogs during recent years. Thus, we can all easily remember when the market tolerated and even required immense hogs weighing from four hundred to five hundred and fifty pounds and of mature age. Later this kind of hog went out of style entirely and in its place we had a demand for young hogs not over ten months of age and weighing one hundred and fifty to two hundred and fifty pounds. Within the past year the pendulum of taste seems to be swinging back again towards the heavy hog and a considerable demand is now felt for heavy hogs of mature age. This is due to the fact that the packers must have material from which to make lard and large quantities of lard can be obtained from these heavy hogs when in a fat condition. The market class of prime heavy hogs includes animals weighing from three hundred and fifty to five hundred pounds. This is the extreme size of the fat lard hog. Butcher hogs weigh from one hundred and eighty to three hundred and fifty pounds and are divided into different subclasses, light, medium and heavy, according to weight. The butcher hog should show the true lard form, viz. with a broad back, well-filled

hams and shoulders, short heavy neck and short legs. Packing hogs may weigh from three hundred to five hundred pounds, but as a rule are of a poorer grade than the butcher hogs. The pork from packing hogs is used for curing or made into mess pork and other pork products. Packing hogs constitute forty per cent. of the hogs which come to the Chicago market. The light hog class includes animals which weigh from one hundred and twenty to two hundred and twenty pounds, and range in age from five to eight months. The form of this class may vary considerably. It includes a number of light hogs of the lard type and also bacon hogs which are used for the production of the so-called Wiltshire sides. Our bacon hogs differ considerably from those preferred in England. Pigs weigh from sixty to one hundred and twenty-five pounds and include about ten per cent. of the swine which are put on the market.

The pork raiser should make himself thoroughly familiar with the demands of the market where he expects to sell his product. Since about two-thirds of the world's supply of pork is produced in the United States and since at least six-sevenths of our hog production takes place in the corn belt, any individual who intends to go into the business of raising pork cannot do better than make a study of the business on the farm of some successful raiser in this region. He will then become acquainted with the type of lard hog which is characteristic of our hog industry and will learn many other practical points which could not otherwise be acquired. Chicago is the greatest hog market in the world and the prices for pork products are, therefore, largely set in this city. The retail dealer, however, may exercise a considerable influence on the price of

pork by holding up the price at a time when pork is tending down whereby the consumption of pork is diminished and the price of hogs will obviously go still lower.

FEEDING HOGS

It has already been stated that the area of extensive pork production is practically identical with the corn belt. In fact, corn and hogs seem to be inseparable in the minds of nearly all farmers who have engaged in the business of raising pork. While corn, as so often stated, is the king of grains raised in this country and while it may be used without any other grain, particularly in the case of nearly mature hogs, it should be stated at the outset that the best results cannot be obtained excepting when some other material is fed with it. In pork production, therefore, we have corn as the chief grain mixed with some other grains such as barley, peas, cotton seed meal, wheat, bran, middlings, soy-beans, etc. to balance the ration, various kinds of coarse forage like alfalfa hay, clover hay, pasture (both leguminous and non-leguminous), roots and fruits, and various waste materials, skim milk and animal feeds. The chief classes of feeds are, however, grains, pasture, roots, skim milk and animal feeds.

Corn.—As already indicated corn cannot be successfully fed alone in the production of pork. Perhaps the most extensive series of experiments along this line have been carried on at the Wisconsin Experiment Station, but nearly all of the agricultural experiment stations where hogs are raised and various other investigators have come to the same conclusion regarding corn, namely that it does not

pay to feed it without other grain. In fact, the experience of pork raisers throughout the country has shown conclusively that if hogs are confined in pens they will not make satisfactory gains if their grain feed consists exclusively of shelled corn or corn meal. For a few weeks hogs seem to relish corn meal or shelled corn, but if the ration is not varied the appetite soon fails and various other unfavorable tendencies appear. Thus, on corn meal young pigs fail to develop sufficient strength of bone and muscle. Even if the first generation fed on corn meal alone does not show great unthriftiness, the constitution is, nevertheless, undermined to such an extent that they become practically valueless for breeding purposes and the stock, therefore, runs out. Moreover the profit from feeding corn alone is much smaller than if some other grain is added to the corn. Thus, in one set of experiments the profit from a ration containing corn, middlings and other nitrogenous foods for balancing purposes was nearly four times as great as that from an exclusive ration of corn. Corn meal not only weakens the appetite, produces light bone and general unthriftiness as shown above, but the gains are unsatisfactory and all of the vital organs, especially the heart, lungs and liver are smaller than where a balanced ration is fed, in fact, smaller than they should be to perform properly the functions of a vigorous animal. It is evident, therefore, from hundreds of experiments that corn is not a desirable food for hogs as an exclusive ration, especially for young growing pigs and breeding stock. The question arises, therefore, what are the supplemental feeds which should be given along with corn meal or shelled corn. For this purpose a great variety have been fed. Thus, in Canada various

nitrogenous grains, chiefly barley, have been added to the grain ration for the purpose of improving the quality of the pork produced and preventing the bacon from being soft. It is not only grains, however, which are fed with corn meal to balance it and prevent the bad effects of an exclusive corn meal ration, but skim milk must also be mentioned among the supplemental feeds to be fed with corn. In Missouri the recommendation is made that alfalfa and clover hay and skim milk are to be considered the best feeds to use with corn in completing the pig's ration. In New Hampshire it was found that when four pounds of skim milk were fed with each pound of corn meal excellent results were obtained in pig production. Pigs which received this ration were the best feeders and made the best gains and the cost per pound of gain was two cents less than with a mixture of corn meal and middlings. In Missouri various grain feeds have been found valuable as supplemental to corn in raising pigs. In this list we may mention linseed meal, middlings, bran, oats, gluten feed, and bone meal. Among these feeds linseed meal gave the most efficient results and the greatest profit. Bone meal and other animal foods, however, especially skim milk, are perhaps better utilized by pigs than by any other of our domestic animals. In one set of experiments in which various other grains were used to replace part of the corn meal in rations for pigs it was found that one ton of linseed meal was equal to seven thousand seven hundred pounds of corn, while a ton of bran was equal to three thousand two hundred pounds of corn.

Cotton Seed Meal.—Among the nitrogenous feeds, which are necessary additions to the ration in securing the greatest effectiveness from corn meal,

cotton seed meal must be mentioned as one of peculiar importance, both on account of its effectiveness and the danger which lies in its careless use. Cotton seed meal has long been known to produce poisonous effects when fed in undue quantities to farm animals. It is less likely, however, to injure beef steers, dairy cows and horses than pigs. Recent experiments seem to indicate, however, that this is largely due to the fact that it is not fed to the larger farm animals in as high a proportion to the body weight as is the case with pigs. The actual cause of the poisonous effects of cotton seed meal on pigs is unknown, but numerous experiments have developed methods of avoiding the bad effects of cotton seed meal while securing all of its great efficiency in the production of pork. It appears that the poisonous effect of cotton seed meal is a matter of dosage or the amount fed. Small amounts may be fed indefinitely, but larger amounts only for short periods. The safe ration is determined by the amount per day and the body weight rather than by the total amount fed. At the Arkansas Experiment Station the safe limits have been carefully worked out and have been proposed as follows: For pigs under fifty pounds, one-fourth of a pound of cotton seed meal per day; for pigs between fifty and seventy-five pounds, one-third of a pound of cotton seed meal per day; for pigs between seventy-five and one hundred pounds, two-fifths of a pound per day; for pigs between one hundred and one hundred and fifty pounds, one half of a pound per day. In addition to these proportions according to live weight, the proportion of cotton seed meal should be about one to five or eight of the other grains fed at the same time while a greater insurance against

poisoning from cotton seed meal is obtained if the hogs are allowed plenty of green forage or are kept on pasture and, particularly, if wheat bran is mixed with the grain. Within these safe proportions the long continued use of cotton seed meal does not give rise to any bad effects. According to other calculations of safe rations of cotton seed meal it may not be used in amounts greater than one-fourth pound to each one hundred pounds of live weight. As a result of experience had with cotton seed meal in Oklahoma, it is recommended that this grain be not added to a greater extent than one-fifth as compared with other grains and that it be fed in alternate periods of two to three weeks. According to the experience which has been had in Arkansas, it is not necessary to interrupt the ration of cotton seed meal provided it is made low enough. In Kentucky it was found comparatively safe to use cotton seed meal in rations of one-half pound per day for each pig, particularly during the finishing period. In Washington the amount of cotton seed meal eaten by pigs during a period of eighty-four days varied from eight to one hundred and fifty-four pounds. After this period of feeding cotton seed meal it was found that the lard was actually adulterated with cotton seed oil to an extent varying from four-tenths to fifteen per cent. in different animals. Only one animal out of the twenty three used in this experiment was badly affected by the cotton seed meal, but the weather was cold during the whole experiment and the pigs were given abundant exercise and large quantities of succulent feed.

The various rice products have been tested but not extensively in pig feeding. Rice bran is not relished by hogs and does not produce a rapid

growth. Rice polish, however, is a good pig feed and in effectiveness is somewhat superior to corn. It appears that seventy-eight pounds of rice polish are equal to one hundred pounds of corn meal.

Wheat is everywhere known as a good feed for pigs. Naturally, in the corn belt wheat is looked upon as rather too expensive for this purpose, but is used as a supplemental feed to balance the corn ration. In the western wheat country this grain is used rather more extensively and has been found to give good results. The effectiveness of wheat in making pork is considerably increased by grinding or soaking. It may also be combined with pea meal. Frosted wheat is almost or quite as good as first quality wheat and, of course, is a much more economic food. In Oregon it has been found that four and one-half pounds of wheat will produce one pound of pork. The effectiveness of wheat is much geater in the first part of the feeding period than in the last part. Shrunken wheat, such as is usually found in wheat screenings, or as the result of rust is usually fed to hogs. A comparison of plump and shrunken wheat showed that sixty-three cents was realized from a bushel of fifty-seven-pounds wheat and fifty-seven cents from a bushel of shrunken wheat weighing forty-four pounds. No hesitation, therefore, should be had in feeding shrunken wheat rations when properly balanced with corn or other carbonaceous materials. In Washington wheat showed itself to be the best food for long continued feeding to pigs. They maintained a more uniform increase on wheat than on any other grain food. Apparently the addition of peas or oats did not increase the effectiveness of the ration. A combination of wheat and barley was a somewhat less economic food than wheat

alone. It has been demonstrated that when hogs bring five and one-half to six cents a pound there is good profit in feeding wheat. Barley, however, may not yield suitable returns at the same price for pork. Likewise, in Colorado wheat gave a handsome profit in the form of pork. Wheat and barley ground together were found to make a well-balanced ration which surpassed corn alone as a hog food. When wheat and barley are ground together and fed in the form of meal better results are obtained in a dry form than in a slop. In Canada it has been found that four and one-half pounds of barley are required for the production of one pound of pork and that pigs on barley will make an average gain of eight-tenths of a pound per day. In some experiments barley has been shown to be more efficient than a mixture of barley, oats and corn. The addition of roots is beneficial in most instances. In Nebraska it was found in a comparison of wheat and corn as food for pigs that the meat of the wheat fed hogs contained a little more lean and was firmer than that of hogs which received corn. In general, it may be stated that wheat may be profitably substituted for corn in feeding pigs so long as the price is not more than nine per cent. greater than that of corn. Wheat is improved as pig feed by soaking. Rye, while usually placed in the same category with barley and wheat, in the list of foods, is less desirable than either of the latter, since it fails to produce as much gain and is not as well relished by hogs. Of the three grains just mentioned wheat stands at the top in the efficiency of pork production, eighty-five pounds of wheat being equal for this purpose to one hundred pounds of barley.

On all farms where hogs are raised, middlings

are used quite freely as one of the grain feeds. It is generally recognized that middlings is a desirable feed to combine with corn. Middlings may be at times too expensive, but if the price is reasonable this food will yield fine profits in pork. Dried distiller's grains have also been tested in feeding pigs, but they proved to be a very poor material for this purpose. At the most they should not constitute more than one-third of the grain ration. When fed to the extent of one-third or one-half of the ration, with corn as the rest of the grain the results showed that there was no profit. In many of the western states millet is cultivated to an extent which makes it an available food for hogs and other farm animals. Millet should be fed ground and when prepared in this way may be offered to hogs ad libitum. It is not quite equal to wheat or barley, but in localities to which it is adapted it should have a place in the rotation of crops for pig feed. While hogs relish millet and thrive on it the results are not so profitable if it is fed as an exclusive grain ration for long periods. Thus, in North Dakota excellent results were obtained for a period of fifty days, while in a longer period of eighty-four days the rate of gain diminished. Apparently, a bushel of millet weighing fifty-six pounds is equal as pig feed to a bushel of barley weighing forty-nine pounds, but pound for pound it requires more millet than barley or wheat to produce a given amount of pork.

Soy-beans are excellent for pigs when mixed with corn in the proportion of one to two. On account of their high protein content this proportion of soy-beans is sufficient to balance a ration of corn in a very satisfactory manner. In the test where soy-beans were compared with middlings the greatest

gain was made on a ration containing one-third soy-bean meal and two-thirds corn meal. As compared with an exclusive corn ration, the pigs fed the ration mixed in the proportion just mentioned made gains twice as great. At the same time it required only three hundred and ten pounds of mixed soy-bean and corn meal to produce one hundred pounds of pork, while on corn meal alone five hundred and fifty-seven pounds were required. The importance of balancing rations in this manner is, therefore, apparent.

Dry vs. Wet Grain.—Considerable controversy has been had concerning the merits of dry and wet feeding of pigs. A majority of careful experiments on this point, however, show that on an average seven per cent. greater gains are made by feeding wet materials than from the same amount of dry material. Occasionally, however, the opposite results are obtained. Thus, in Utah better gains were made on dry bran and corn meal or dry ground wheat than when these materials were fed wet. Similarly, in experiments in Idaho there seemed to be a small margin in favor of feeding both whole grain and meal in the dry form rather than wet. The relative advantages, however, were not sufficiently marked to make any great difference in favor of either method. Ordinary farm practice should be guided by the preponderance of evidence gained from careful experiments, which indicates a slight advantage from wet materials and a somewhat larger advantage from soaking whole grain for pigs. Whether or not this be done would depend on the expense of the operation and the conveniences at hand for carrying it out.

Whole Corn vs. Corn Meal.—A large difference of opinion has always prevailed regarding the value

of grinding grain for hogs and a larger number of experiments have been carried out with corn in testing this matter than with any other grain. At the Wisconsin Experiment Station, a continuous series of experiments was made for eight years with a great uniformity of results. It appears from this careful work that there is a saving of seven per cent. of the corn by grinding it to meal before feeding in combination with middlings or other nitrogenous grain for balancing corn. Whether or not it will pay, therefore, to grind corn will depend entirely on the distance of the farm from mills or whether the farmer has a feed mill on his premises. With some other grains such as Kafir corn, millet, screenings, and shrunken wheat it is always best to grind into meal before feeding, since otherwise a considerable part of it will pass through the intestines undigested. The experimental results just mentioned on the question of wet vs. dry grain and ground vs. whole corn are based on American experiments. In Canada all of these questions have also been tested with somewhat similar results. From the Canadian experience, it appears that merely wetting meal does not aid in its digestion, while soaking it for twenty-four to thirty-six hours is of considerable benefit. Canadians recommend that nearly all grains be fed ground for pigs. This, it appears, in their experience was more important in the case of oats, peas and barley than for other grains. Soaking for a day or two before feeding will render the meal more digestible. With regard to the amount of water which should be used in wetting grain, it should be stated that in fattening pigs a thick slop is certainly preferable while for pigs on pasture or for breeding stock the slop may be much more diluted. In cold

weather the question may arise regarding the relative value of feeding corn or other materials warm or cold. It is a decided help to the thrift and health of pigs to feed warm meals at least once or twice a day during cold weather. Grain need never be cooked for swine and, in fact, experiments show that most grains are more readily digested in a raw than in a cooked condition. With roots, again the question of whether they should be fed raw or cooked is to be answered differently in the case of different roots. For example, potatoes, turnips and pumpkins give better results cooked than raw while sugar beets, common beets and other roots need not be cooked.

Condimental Feeds.—This is a rather delicate question to discuss in connection with pigs as well as with other animals for the reason that such diverse opinions prevail. As a rule, there is no special objection to the use of proprietary stock feeds. Some of them contain a suitable amount of nutriment to keep pigs or other animals in good condition. The chief objection to them usually lies in the fact that the price is excessive and far beyond their real value. Under ordinary conditions the farmer can prepare his own condimental foods and do it much cheaper than by means of purchased material. As a matter of fact, if suitable variety is introduced into the ration, and particularly if the rations are balanced, using corn as the basal part of the grain fed and supplementing it with wheat, barley, cotton seed meal, peas, bran, middlings, screenings, etc., there is no occasion for the use of condimental feeds, since pigs do not get off their feed and do not require any stimulant. If the need is felt for a tonic feed, small quantities of linseed meal may be given. The condiments

which hogs require most and which must be accessible to them at all times are charcoal or ashes and salt. It is strictly necessary that an abundant supply of charcoal or soft coal should be provided hogs that are maintained in pens or during the winter when the ground is frozen. There seems to be a natural requirement for this material on the part of all hogs and it must be provided, if the best results in health and strength of bone are to be obtained. A good plan consists in mixing ashes, charcoal, air slaked lime and salt. Pigs eat about one-tenth of a pound of salt per day and eat the charcoal and ashes as fancy strikes them.

COARSE FORAGE

The stomach of the hog is not large as compared with that of cattle or sheep. It is more like that of the horse in size and the digestive process resembles that of the horse, except that it is considerably more active. The hog, however, is an omnivorous animal and not a ruminant and is, therefore, not adapted to utilizing large quantities of coarse fodder in a profitable manner.

In the arid states where alfalfa is such an important forage crop it has been found that alfalfa hay is readily eaten by hogs to the extent of one-half of a pound per day in addition to a pound or more of sugar beets and a suitable grain ration. Where alfalfa hay is fed in self feeders it is always observed that hogs spend much of their time pulling it out and eating it between the regular feeding times for grain. Where tests have been made to determine the relative value of alfalfa hay and grain, it has been demonstrated that five pounds of alfalfa hay may be used to take the place of three pounds

of mixed grain. One ton of alfalfa hay will produce from two hundred and fifty to eight hundred and fifty pounds of pork, depending on the quality of the hay and the character of the pigs. The second cutting of clover hay may be boiled before feeding to pigs and in this form is somewhat more efficient as a pork producer than clover silage. Silage is not fed as extensively to hogs as to dairy cows, steers and sheep. It is rather too bulky for the digestive organs of the pig and for this reason should not be fed to a greater extent than one-fourth of the ration. For brood sows, however, it is valuable in increasing the flow of the milk. Silage cannot be depended upon to replace any of the grain, but when fed in addition to grain it yields a profit since quicker gains are obtained and the hogs remain in excellent health.

PASTURE

A large variety of field crops are commonly cultivated as hog pasture. It is almost universally recognized that while hogs do not require a large amount of coarse forage in a dry form they can utilize more material in a green state by grazing on it or when fed in the form of soiling crops. In the South, peanuts, chufas, cowpeas, sweet potatoes, sorghum, vetches, oats and rape may be depended upon to furnish a continuous series of green material for hogs during a long season. The amount of grain required per pound of pork produced on pasture composed of these various crops varies from one and seven-tenths pounds in the case of peanuts to three and seven-tenths pounds in the case of sorghum. Chufas, peanuts, cowpeas, artichokes, and other roots are readily harvested by the hogs with good results and no expense is in-

curred by the farmer on this score. The only objection to peanut and chufa pasture is that the lard of hogs which are fed on these materials is very soft. Canadian hog raisers depend on rape, vetches, a combination of oats and peas, soy-beans, red clover, alfalfa, artichokes, mangels, carrots, and turnips, as pasture crops for pigs. Artichokes as pig pasture should be planted in the spring and the crop is then ready for use about the end of September. The best way of harvesting them is to let the pigs do the work. In Utah a test was made of the rapidity and the economy of gain in feeding hogs on pasture, in pens and in yards. In this test, a field of alfalfa pasture was eagerly eaten, but it appears that such pasture furnishes simply a maintenance ration for hogs and that grain must be given in order to secure rapid gains in weight. Pigs kept on alfalfa pasture from spring until fall gradually ceased to gain in weight after the first of October. This indicates clearly the necessity of feeding grain even under the best pasture conditions in order to prevent a check in the growth of the pigs. Since, however, alfalfa pasture is at least a maintenance ration it may be used economically in pork production in combination with a small amount of grain. As compared with pigs which were fed in pens there was a noticeable difference in favor of those which were allowed the freedom of pastures. Pigs on pasture with a small grain ration produced gains at the least cost and with the greatest rapidity. It has been demonstrated beyond question in many of the far western states that alfalfa and sugar beets are a highly profitable ration in pork production, when fed in connection with a limited ration of grain. In Kansas, a test was made of fattening three lots of hogs, one on

alfalfa pasture, one on rape pasture and one without pasture. It was shown in this experiment that on alfalfa pasture three hundred pounds of grain were required for one hundred pounds of pork, on rape pasture three hundred and one pounds and without pasture three hundred and seventy-one pounds. The daily gain of the hogs was fastest on alfalfa pasture and least in the lot without pasture. The pork-producing value of alfalfa in this test appeared to be about $25 per acre. Green peas also constitute a valuable pasture crop for pigs when supplemented with a small ration of shorts and skim milk. The black-eyed marrowfat is a valuable variety for this purpose. When pastured in this manner one-fourth acre of peas is sufficient to carry nine mature hogs for two months or more. The pork-producing capacity of peas is about $60 per acre when grazed under proper conditions.

In general pigs like other animals waste a considerable portion of pasture, if allowed to graze freely on it. It is customary, therefore, to graze them in hurdles, using a system of movable fences so as to confine them at will. This system however has the objection that the crop may be injured by too close grazing and tramping if the hogs are not moved at sufficiently frequent intervals. When grazed in the hurdle system it has been found that an acre of peas will maintain about four thousand pounds of live hogs for a period of two weeks and produce about 170 pounds of pork during this time. Peas are usually sown mixed with oats as a hog pasture and this combination is a very successful one, since the oats serve as a sort of nurse crop and assist in holding the peas off the ground.

Rape is generally recognized as an excellent

crop for hog pasture. Not all experiments with this crop have given equally successful results. In Wisconsin rape was found to be a better hog pasture than clover pasture and pigs made gains on a much less quantity of grain than was required for the same gain on clover pasture. For hog pasture it is recommended that rape be sown in drills about thirty inches apart and that the hogs should not be turned upon the crop until the plants are about a foot high. Rape, however, is not sufficient by itself, but a fairly good sized grain ration must be fed in combination with it. From Utah comes a less favorable report concerning rape. Pigs appeared to like it after a few days' trial, but the gains which they made on rape pasture were small and the amount of grain required for each pound of pork produced was too large. Moreover, the crop was greatly injured by attempting to hurdle the pigs, therefore, the total productiveness of the rape crop was much reduced. In many parts of the country a succotash mixture as a pasture crop for hogs is much in favor. For this purpose one mixture quite strongly recommended consists of one peck each of corn, peas and oats and six quarts of barley sown at the rate of two and one-half bushels per acre.

If we consider the economy of feeding in each case, of course, the final test of efficiency in this matter must be based on which combination of pasture and grain gives the best results. The nature of pasture will of course vary according to the locality. Dwarf Essex rape, field peas, vetches, soy-beans, alfalfa, and clover are valuable crops for the production of pasture for hogs. Pasture not only furnishes a great amount of nutri-

tious feed for hogs at an economic rate, but serves to maintain a proper state of the digestive organs in pigs and furnishes them with the needed amount of exercise. In some instances where pen feeding and pasture feeding have been compared, the most economic gains have been made by feeding pigs in pens. The majority of experiments, however, show clearly that hogs must have sufficient exercise to enable them to maintain their appetite. Under ordinary circumstances no extra amount of care or feeding can take the place of this natural requirement.

Roots.—As already stated a large variety of roots and fruits may be profitably fed to pigs. According to extensive experiments by Canadian feeders who have given much attention to this subject roots and similar foods are rated in the following order according to their palatability and value as pork producers. Artichokes, potatoes, sugar beets, mangels, carrots, turnips, apples, pumpkins, kohl rabi, cabbage and ensilage. These feeds, while furnishing much valuable nutriment and succulence and aiding the digestion, must be fed to the extent of five hundred to one thousand pounds to equal one hundred pounds of mixed meal in the production of pork. Naturally, only spoiled or windfall apples will be used in feeding pigs. Similarly with cabbage, the best part of the crop is too expensive for feeding. Other roots, however, may be fed to hogs under ordinary conditions with profitable returns. Apples merely constitute a maintenance ration for swine. In Oregon it was found that three shoats eight months old ate one thousand, one hundred and nineteen pounds of apples in fifteen days. At the end of that time, however, they began to

lose weight. When grain was added to the ration the pigs kept in excellent condition and the digestive value of apples is thereby made apparent. Sugar beets have been perhaps more extensively tested as a hog food than any other common root. In Utah hogs have been found to gain in a very satisfactory manner on a ration of two pounds of bran per day and sugar beets ad libitum. Sugar beets may be profitably used as a part of the ration for pig feed during the winter months throughout the pork-producing area. In Montana when two sets of pigs were fed for the purpose of comparison, one lot receiving a grain ration only and the other receiving sugar beets in addition to the grain, the pigs which received the sugar beets made a slightly larger daily gain and produced pork one cent per pound cheaper than those which received grain only. If sugar beets are fed to hogs they may be harvested and fed whole or the hogs may be turned into the field and allowed to do their own harvesting. Very little of the crop is wasted by the latter method and all of the expense and labor of harvesting is obviously saved. On all farms which are conveniently located to sugar factories or to which the pulp may be shipped by rail, sugar beet pulp may be fed with profit in fattening hogs. The value of pulp for feeding is nearly equal, pound for pound, to that of sugar beets. Beet pulp should not be fed in too large quantities. In Colorado the pulp proved to be a profitable addition to the ration of growing pigs and also to the grain ration at the first period of fattening. The feeding value of sugar beets and also of the pulp appeared to be about $1.50 per ton. The pulp, however, served the same purpose as the beets and could be ob-

tained at a slightly less expense. Pigs do not always take kindly to beet pulp and it may be necessary to mix some meal or grain with it in order to induce them to eat it.

Skim Milk.—All dairy by-products may be very profitably utilized in making pork. Pigs are particularly well adapted to transforming these products into meat. They make gains as fast or faster than young calves and do not require as careful attention to the condition of the milk as is the case with calves. Skim milk may, therefore, be fed sweet or sour and whey and buttermilk may also be utilized in feeding pigs. Much attention has been given to the question of the proportion between skim milk and corn meal or other grain in feeding pigs. The rate in which these materials are fed in actual practice on the farm varies greatly. Thus, in Tennessee skim milk was fed at the rate of three to five pounds to one pound of corn meal. In these tests skim milk appeared to have a feeding value of twenty-eight cents per one hundred pounds. Since corn is a highly carbonaceous grain, the protein necessary to balance the ration may be very easily secured in skim milk and these two feeds seem to make an almost ideal mixture for pork production. The injurious effects of exclusive corn feeding are entirely done away with by adding skim milk to the ration and the strength and vigor of the pigs are maintained at a high point and they do not get off feed. Moreover, the meat of hogs fed on this ration has a most desirable flavor and shows a proper marbling and intermixture of fat and lean. The profit from feeding a mixture of skim milk and corn meal is always far greater than can be obtained by feeding corn meal alone. At Cornell Uni-

versity the most profitable gains in pigs were made when skim milk and corn meal were fed in the proportion of one to three. Various other tests were made, however, during subsequent years and it has been found that a considerable variation may prevail in this respect. Thus, corn meal may be economically fed with from three to eight times its weight of skim milk. It is ordinarily safe to feed skim milk in as great a quantity as the pigs will readily consume. Wherever attention has been given to determining the actual feeding value of skim milk in the northern central states it has been found that it is worth fifteen cents or more per one hundred pounds in the production of pork. The more skim milk pigs will eat readily the more grain can be saved in compounding the ration and for this reason the more economic is pork production under the circumstances. Skim milk may not only be fed with corn meal, but with any grain ration such as a mixture of corn and wheat meal, soy-bean meal, linseed meal, gluten meal, or animal feeds. In a series of tests in which skim milk was fed in amounts varying from three to twelve pounds for each pound of corn meal or mixture of corn and other meal, it was found that the gain per head per day on corn meal alone was one-third the gain of pigs which received skim milk, corn meal and wheat meal, while the cost of each pound of gain was much higher on the exclusive corn meal ration and the profit about one-seventh of that obtained from the skim milk and meal ration. As already indicated the consumption of skim milk reduces the amount of grain necessary, so that the economy of production is much greater. Rations containing skim milk have been fed to pigs throughout

the country and everywhere give very satisfactory results not only in the cost of production, but in the gains of pigs. The same story of the great value of skim milk comes from the southern states, Arizona, and other parts of the southwest, Oregon and Washington, the central dairy states and Canada. On the basis of Canadian experience, it is recommended that skim milk be fed in rations of five pounds for each pig daily. In Canada skim milk has been found to possess a feeding value about one-fifth as great as that of corn.

Molasses.—While cheap molasses and various other sugar cane and sugar beet products are coming into great value in feeding horses, mules and steers these materials do not give much promise as profitable pig feeds. To be sure they have not been thoroughly tested with pigs, but in one experiment where a pen of five pigs received eight pounds of corn meal, twelve pounds of molasses and twenty pounds of skim milk daily the pigs soon got off feed and some of them died. The molasses seemed actually to exercise a poisonous effect upon them and it became necessary to leave out this part of the ration. Since there are so many other excellent feeds known to produce pork under economic conditions, it appears at present, at least, to be unnecessary to attempt to use molasses as a pig feed.

Tankage and Other Animal Materials.—Of all domestic mammals pigs make the best use of animal feeds. Every one who has been near country slaughter-houses knows that a considerable number of pigs are constantly kept about such places and fed on the offal of slaughtered animals. They make very satisfactory gains on

such material, but objections may be made to the practice on a sanitary basis since pigs fed in this way may become tuberculous or infested with trichina. Tankage as it comes from the slaughter-houses is variable in quality, but always contains a high percentage of protein and is, therefore, suitable for balancing rations of corn. This material is fed in large quantities and always with profitable results. It may be fed at the rate of a pound to five or ten pounds of corn meal. When tankage is added to a ration containing corn meal the cost of production is diminished by nearly two cents a pound. Moreover, tankage does not show any injurious effects on the quality of the meat and, in fact, the pork of tankage fed hogs is firmer than that from hogs which receive only corn; and the strength of bone and general finish of hogs when receiving tankage is of the very best.

Attention has already been frequently called to the fact that corn meal is not a satisfactory ration in producing pork. The necessary protein for balancing corn may be obtained not only from nitrogenous grains and leguminous forage plants, but from animal meals. We, thus, have other sources of protein for adding to the grain to give strength and vigor to hogs during the fattening period and to prevent them from getting off feed. In some cases tankage does not give quite as favorable results in pork production as middlings or soy-beans, but it is ordinarily a very valuable and successful feed for pigs. As already indicated tankage is only one of the various animal feeds which may be fed to pigs. Different packers furnish different grades of tankage and in addition to tankage proper we may use

beef scraps, bone meal, animal meals, and various other animal products.

The Cause of Soft Pork.—Nearly all feeds have an effect upon the softness or firmness of bacon or pork in addition to their feeding value. It is necessary to give some attention to this in order to secure pork of the highest market quality. The standard of firmness for pork varies somewhat in different parts of the country. Thus, in the southern states corn is frequently referred to as producing a firm pork as compared with chufas, peanuts and various other feeds which are known to produce a very soft pork and lard. Cotton seed meal, however, is well-known as a hardening feed. It not only produces a firm quality of lard and pork, but also has the same effect upon tallow, butter and other animal products. The Canadians have given more attention than have we to the production of a fine grade of bacon according to the requirements of the English and Danish markets. The soft pork problem has, therefore, been extensively investigated by Canadian hog raisers. According to their experience and also that of American feeders throughout the corn belt corn produces a pork which is too soft. It is necessary, therefore, to add some nitrogenous grain, skim milk or some other material to balance the corn and secure firm bacon. Among the feeds which have the tendency to produce firm bacon we may mention barley, blood meal, bran, clover hay, wheat, oats, oat meal, turnips, rye, shorts, skim milk, speltz, emmer, distiller's grains, tankage, whey, and whole milk. The common farm feeds which have the opposite tendency or produce soft pork include peas, buckwheat, city refuse, corn and gluten feeds.

While both corn and peas have a decided tendency to soften pork rendering it less valuable as bacon or for the production of fine cuts of meat this tendency may be overcome by feeding skim milk. A mixture of oats, peas and barley in equal parts produces an excellent quality of pork. Skim milk may also be added to this mixture. If fed in connection with a good ration, rape, pumpkins, artichokes, sugar beets, turnips and mangels do not injure the quality of the pork. In fact, the value and the firmness of the pork may be slightly increased by feeding these roots. This has been found to be particularly true where roots have been added to a mixed grain ration. Perhaps the best proportion is obtained by feeding roots in quantity equal to the grain ration. As already indicated, the desirable amount of succulence for pigs may be obtained from pasture, silage, or from soiling crops as well as from roots. A moderate amount of clover, vetch, alfalfa and similar crops has a beneficial effect on the quality of the pork. In addition, the softness of bacon may be due not only to feeding an improper ration, such as corn meal or peas exclusively, but to too little exercise, lack of thriftiness in the pigs, lack of finish and any check which may occur in the process of fattening. As already indicated, it has been found in the South that the melting point of lard from pigs which are fed large quantities of chufas and peanuts is much lower than when they receive corn in addition to their other grain. Thus, in Arkansas, the melting point of lard from pigs fed on chufas and peanuts was ninety-three degrees F. and on corn one hundred and one degrees F.

Various feeds not only have an effect on the soft-

ness, value and quality of the meat, but on the strength of bone in hogs. This is an important matter from a practical standpoint since hogs are heavy animals as compared with the size of their legs and are, therefore, particularly susceptible to bone fractures in transportation. The fracture of a leg in transportation is equivalent to the loss of the hog, since they can be sold for little or nothing. The meat is greatly injured in appearance in the region of the bone fracture. Numerous feeding tests have been made to determine the difference in strength of bone in hogs fed different rations. After such experiments are carried to a conclusion the thigh bones are taken and the breaking strength determined in a manner similar to the method adopted in the case of timber tests. In such tests, for example, it has been found that the strength of bone in hogs fed corn and skim milk is sufficient to support four times the weight of the body, while on corn and beef meal it is sufficient to support eight times the bodyweight. Beef meal and other animal feeds have a striking effect in increasing the strength of the bone. On the other hand, exclusive feeding of corn will so weaken the bones on account of the lack of sufficient mineral matters that spontaneous fractures occur in the legs in the ordinary movements of the pig in getting up and down and in walking about the yard.

It is a matter of some practical interest to know the amount of milk secreted by the sow. From careful tests carried out to determine this point it appears that Berkshire sows yield about six pounds of milk daily, Poland Chinas five pounds, and razorbacks slightly more than five pounds. The total amount of milk yielded by the sow during

an average period of lactation varies from four hundred to five hundred and thirty pounds with an average of four hundred and sixty-five pounds. The milk of sows varies greatly in its composition. Thus, the fat may range from four to twelve per cent., but is always higher than in cow's milk. In connection with the amount of milk yielded by sows, the question is frequently argued whether greater gains will in the aggregate be made from small or large litters. As a rule, pigs in large litters are more thrifty and show better appetite than those in small litters. Some of the pigs in large litters, however, may be killed by the sow so that the total production of pork is somewhat reduced. The production of large litters indicates unusual vigour on the part of the sow and this quality is usually transmitted to the offspring. The milk production of sows has been found to vary considerably according to their temperament and feeding, in much the same way as is observed in cows.

It is sometimes thought that sows should not be overfed before the pigs are weaned and that no effort should be made in this way to hasten the growth of the pigs. It is possible, however, to force the sow to such an extent as to increase greatly the rate of growth in the pigs before weaning and such extra feeding has been found to be an economical practice. Ordinarily when this is done the amount of food consumed by the sow and utilized by her in maintaining her own weight and in increasing the weight of the pigs is about the same as that required by the pigs after weaning.

The proper age for weaning pigs is eight weeks. The practice on this point varies with different

farmers from seven to ten weeks. It is ordinarily best to take away two or three of the strongest pigs and thus gradually remove them from the sow so that no trouble arises in the way of inflammation of the udder.

The sow may be depended upon to carry her pigs ten weeks, the actual time varying from one hundred to one hundred and fifteen days. The weight of pigs at birth varies from one and one-half to three pounds with an average of two and one-half pounds. The total weight of litters from prolific sows is usually about 15 pounds.

Age in Relation to Cost and Rate of Gain.—It is a general law which holds true for all domestic animals that less food is required for a given amount of gain in young animals than in adults. The amount of food required for each pound of gain increases uniformly with the increase in age. Conversely the rate of gain decreases as the age increases and consequently the economy of gain decreases with the age of the animal. This fact should not be surprising, since it is well-known that the digestion is much more active in young animals than in adult animals and, therefore, the food is better utilized. Not only are the rate and economy of gain decreased by the age of pigs, but they also depend to a considerable extent on the length of the fattening period. No animal can be successfully fed beyond a certain period, which is usually quite limited. In cattle it may range from four to six months, but in pigs it is considerably shorter. As a rule, pigs make their best gains during the first month of fattening and after that considerable difficulty is experienced in producing economic gains. In other words, they are more

apt to get off feed and consume more feed for a given amount of gain until a point is reached where their feeding can be accomplished only with an absolute loss. It is, therefore, apparent that the rate and economy of gain diminishes as the length of the feeding period increases. As a rule, this period should not last more than three months. In fact, some hogs may be brought to an excellent condition in fifty or sixty days. This is particularly true if the pigs are kept growing without any check in their development from weaning time until five to ten months of age when they may be sold for pork.

In the western states, where the extent of the Chinese population is sufficient to create a market for young pigs, considerable attention is given to this business. The pigs are forced by heavy feeding of the sow before weaning and are then fed as heavy grain rations as they will eat until they are about three months old. After rapidly forcing them to this time they may be sold at a very profitable figure.

Water.—The amount of water which is usually required by pigs is a matter which has not been generally studied. As a rule, pigs will drink two or three pounds of water for each pound of grain consumed. Since, however, few farmers furnish water to pigs in troughs or other receptacles where it can be measured this is not a matter of great importance. It is desirable, however, that more attention be given to this point and that the quality of the water furnished to hogs should be better. It requires but little thought to convince one that the practice of allowing hogs to wallow in mire and secure their only water from this source is very reprehensible.

THE RAZORBACK AS COMPARED WITH THE PURE BREEDS AND GRADES

The quality of all animals on the average farm is undergoing a gradual improvement. We, therefore, see fewer razorbacks than formerly except in some of the less cultivated parts of the South. The razorback hog differs from the improved breeds not only in general form of the body, length of the leg, shape of the head, but also to some extent in the length of the intestines and its general capacity for utilizing food in an economic manner. In a number of tests in which razorbacks have been compared directly with pure breeds like the Poland China and Berkshire it appears that it costs about one-half cent per pound more to produce pork on razorbacks than on the pure breeds or on crosses between razorbacks and pure breeds. In the case of skim milk it appears that razorbacks are capable of utilizing this food in as economic a manner or even more successfully than pure breeds. This may be due to the fact, however, that razorbacks do not do well on concentrated grain rations of great size. They always require an abundance of pasture and more bulky food than do pure breeds. Razorbacks are generally objectionable for several reasons. They do not fatten uniformly. Some may put on weight rapidly and others slowly so that a pen of them cannot be kept in the same condition of fatness. Then, too, the form varies greatly as well as the firmness of the meat. Moreover, they cannot be forced to as large size as is easily accomplished with pure breeds. There is, therefore, no excuse for raising them since pure bred boars of excellent quality can be obtained for $25. The claim

is sometimes made for the razorback animal that he is more resistant to hog cholera and other infectious diseases than pure breeds. This matter, however, is a doubtful point. It has not been shown by experiments and it appears that if pure breeds are properly fed and allowed exercise under sanitary conditions that no great difference in susceptibility to infectious diseases can be observed between the pure breeds and razorbacks.

When it comes to a comparison of different pure breeds great difference of opinion prevails, depending on the particular purpose for which the breed is raised. On the basis of the experience of Canadian hog raisers it appears that in economy of gain the pure breeds stand in the following order: Berkshire, Tamworth, Yorkshire, Duroc Jersey, Chester White; while for the production of bacon the breeds stand in the order, Yorkshire, Tamworth, Berkshire, Chester White, Duroc Jersey and Poland China. In a feeding period of four months, the Canadians found the greatest gain in the Yorkshire and the least in the Tamworth. The relative position in which the breeds stand in different tests is, however, not always the same as shown by experiments at different times by the same feeder. The Yorkshire and Tamworth are obviously the best breeds for the production of bacon for export while in most tests the Berkshire seems to be at the top in economy with which feed is utilized. A number of crossbred hogs have been found to be very desirable for the production of bacon. Thus, crosses between the Tamworth and the Poland China are very fine animals for this purpose. In fact, according to many experiments, crosses appear

to be superior to pure breeds in the economy with which feed is utilized. Thus, in Kansas, crosses between the Poland China and Duroc Jersey, Berkshire, and Tamworth produced a pound of gain on less grain than pure bred Poland China, Duroc Jersey or Berkshire.

The dressed weight of the different breeds varies somewhat, but does not differ uniformly with the breed. In one series of experiments on this point the dressed weight was highest in the Poland China, being eighty-three and five-tenths per cent. and also lowest in poor specimens of the same breed. The dressed weight of the Berkshire was eighty-two and nine-tenths per cent., Duroc Jersey eighty-two per cent. and Tamworth eighty-one per cent. The weight of the hams in the same test varied from thirty-four pounds in the Poland China to ten pounds in small Duroc Jerseys with an average of twenty-five pounds in all breeds tested. The Berkshire usually shows more lean and less fat than the Poland China in the development of the hams and shoulders.

Some difference of opinion prevails regarding the value of runts. Unfavorable results with runts are sometimes due to not giving them a chance, it being taken for granted that they are not worth wasting feed upon. It occasionally happens that runt pigs can be bought for a very low price and when well-cared for and fed suitable rations they make profitable returns. In one test with runt pigs in Kansas one hundred pounds of gain were made on every three hundred and thirty pounds of grain consumed and this result is equal to or better than the result obtained in ordinary pig feeding.

BREEDS

A few descriptive notes may now be added on the general characters of the different breeds of hogs which are raised in the United States. The intimate connection of the hog and corn industry is clearly shown by the fact that the area of the production of fine hogs is almost co-extensive with that of the corn belt. In fact, six breeds of improved hogs originated in the corn belt of the United States. These are Chester White, Ohio Improved Chester, Poland China, Cheshire, and Victoria. The breeds of hogs are frequently classified on the basis of their color. If this is done the white breeds are Chester White, Ohio Improved Chester, Yorkshire, Cheshire, Victoria, and Suffolk. The black breeds are Poland China, Berkshire, Hampshire, and Essex, and the red breeds are Duroc Jersey and Tamworth.

The Poland China.—This breed originated in Ohio about twenty-five years ago from a mixture and improvement of the Big China, Poland and Byfield breeds. The Berkshire was also mixed with the Poland China. The present name for the breed was finally adopted in 1872. At first this hog was black and white spotted, but at present the color is black with white on the feet, face and tip of the tail. The face is somewhat dished. The breed at present is about equal to the Berkshire, matures early and is readily adaptable to all climatic conditions. It is the extreme type of the large lard hog, boars weighing six hundred pounds and sows five hundred pounds at two years of age. Occasionally the Poland China is not so prolific as it should be, but the weak points of the breed are being rapidly overcome.

The Berkshire originated in England from a mixture of native and imported breeds. The original color was reddish with black spots, but at present the color is black with white spots like the Poland China. The face is similar to the Poland China, but the ears are short and erect and the neck exceedingly short. The bone of the legs is fairly strong, but not equal to that of the Poland China. In size also they are somewhat inferior to the latter, boars weighing about four hundred and fifty pounds and sows four hundred pounds at two years of age. The weak points of the Berkshire are not serious, but it has suffered somewhat from being forced too much in feeding so that its fertility is somewhat diminished.

The Hampshire or Thin-Rind, also known in its earlier history in this country as the McKay or Belt breed, came from the Hampshire region of England and then through Canada into New York, Kentucky and the corn belt. The color is black with the exception of a white belt, which encircles the body around the shoulders, including the fore legs. It is a prolific breed, the sows are good mothers, they are excellent rustlers with good, strong legs. The Hampshire matures early and it is claimed for the breed that the weight is chiefly distributed in the better cuts of meat.

The Essex also comes from England and was introduced into the United States about 1850. At maturity this pig may weigh six hundred pounds and the breed matures very early. The quality of the meat is good and the Essex is a desirable hog for crossing on other breeds. The color is black, the face small and broad, the ears erect, but drooping with age, and the hair fine and very free from bristles.

The Chester White originated in Pennsylvania and the name was at first given to nearly all hogs of a white color. Some crossing with the Yorkshire, therefore, probably took place. As a rule the Chester White is not equal in quality to the Poland China. The strong points of the breed are its grazing ability, hardiness and fertility. In size it is about equal to the Poland China. Within the past few years the Ohio Improved Chester has originated by selection and improvement, based on the Chester White. This breed has become quite widely distributed and it is claimed that some of the weaknesses of the original Chester White have been eliminated.

The Yorkshire came from England and is already quite generally distributed throughout the country. The large Yorkshires are perhaps longer than any other breed of hogs, but not so broad as the Chester White. They mature at a medium early age and the quality of the meat is excellent. This breed is the standard one for the production of bacon and in their length of body they form the required bacon type.

The Cheshire originated in New York and has been maintained pure since 1873. They are of medium size, mature early, are fairly good grazers, and are medium breeders. The color must be uniformly white without any black hairs.

The Victoria breed also originated in New York and Indiana. At present it shows a tolerably wide distribution in the country. The Victoria stands next to the Poland China in size, but in this point they are not uniform. They mature at a medium early age and the quality of the meat is good. The color is white with an occasional black spot on the skin. They are not so large nor so uniform in size as are the Berkshire.

The Suffolk originated in England and has obtained some foothold in the United States. They do not reach a large size and produce rather small litters. The Suffolks mature early and may be marketed in a fairly good condition at six months. The legs are rather long with a long, rather cylindrical body.

The Tamworths originated in England and for a long time were not largely distributed outside of their own country. Within recent years they have been imported quite extensively into the United States and Canada. In size the Tamworths are about equal to the large Yorkshire. They mature at a medium early age. The chief points claimed for the Tamworth are that they are unexcelled for fertility and the quality of the meat for bacon production, the Tamworth and Yorkshire being the two chief bacon breeds. The color is a reddish chestnut which darkens somewhat with age.

The Duroc Jersey originated in New York, apparently from a mixture of the Duroc and Jersey breeds. They are comparatively small in size but are good rustlers, mature early and show a relatively large proportion of lean meat. The Duroc Jerseys are not equal to the Berkshires for bacon production but otherwise the two breeds do not differ in a pronounced manner.

So much for the chief characters of the breeds with which we have to deal in pork production. In general it should be remembered that the white breeds are more limited in distribution than the black or red breeds for the reason that in the southern states the white breeds are affected with sun scald and therefore cannot compare with the black and red breeds.

Diseases of Pigs.—The farmer, of course, is chiefly interested in the positive side of the pig business, that is in the production of pork. In order to make a great success of this, however, it is necessary to become acquainted with the various drawbacks which may be brought by disease. Pigs, like other farm animals, are subject to a variety of diseases, but not all of them are of great seriousness. The chief drawbacks to hog raising throughout the corn belt are found in hog cholera and swine plague. These two diseases, or, as it appears from recent investigations, three diseases, there being two forms of hog cholera, sometimes occur separately or are found together in the same hog, and when once the infection has become established on the farm it is somewhat difficult to get rid of it. Hog cholera is an infectious disease which attacks chiefly the intestines and corresponds most closely to typhoid fever in man. The appetite suddenly disappears, a high fever is seen and the bowels may be constipated or be affected with a profuse diarrhea. The affected hogs often hide themselves in corners of the yard or crawl under straw or rubbish. A red coloration may appear on the skin of the ears, neck and flanks. The animals may die in two or three days or may linger for a month or longer and the mortality is eighty per cent. or higher.

Swine Plague differs from hog cholera in that the chief seat of the disease is in the lungs so that the disease may be described as more nearly pneumonia and the infection takes place through the air while in hog cholera it takes place in the food. Otherwise the two diseases resemble one another very closely and, in fact, sometimes can-

not be distinguished except by microscopic study. No remedy is known for either hog cholera or swine plague and thus far vaccination for these diseases has not given uniformly good results. The work of the Bureau of Animal Industry and various experiment stations along this line gives promise of a satisfactory solution of the problem.

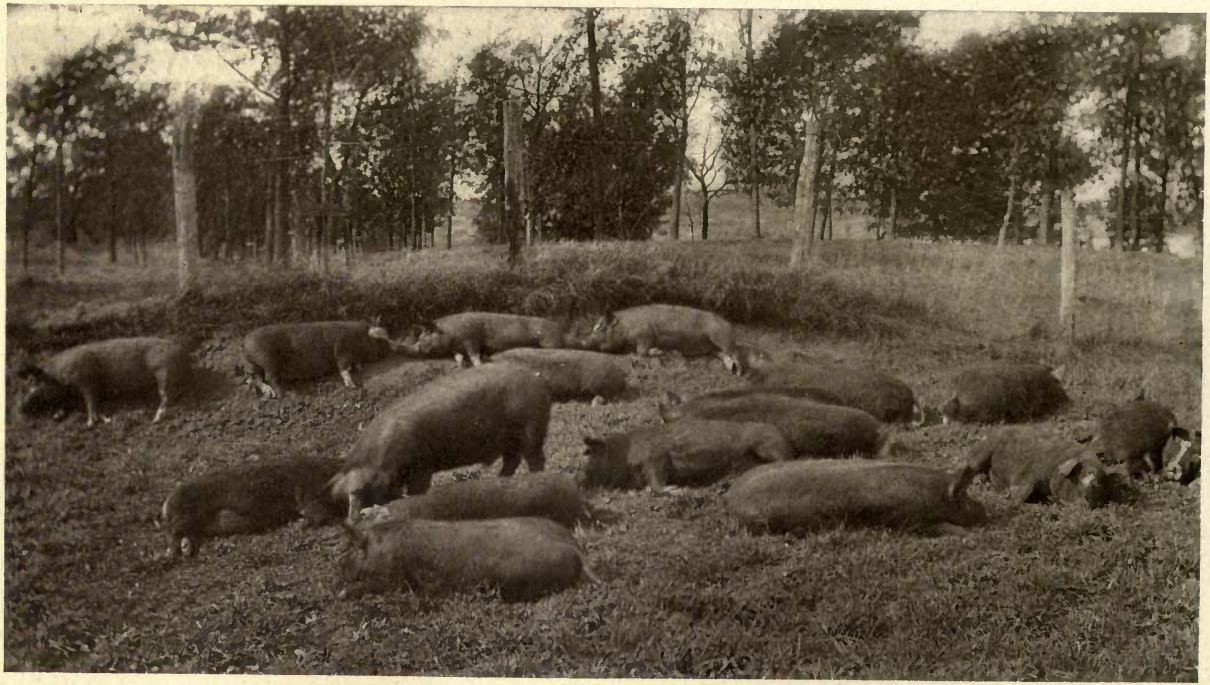
In order to avoid infection with this disease it is desirable to watch the food and water supply carefully and to quarantine hogs from suspected localities for thirty days before allowing them to run with the farm herd. It is also a good plan to move the hog yard from time to time to different parts of the farm. In this way the old yards may be plowed up and cultivated and the hogs are kept in clean quarters and the filth is not allowed to accumulate indefinitely.

Hogs often become infested with lice and other parasitic insects, as well as with the mange. Mange appears first on the head and later, if untreated, may spread over the rest of the body. This disease may become so serious that it is desirable to dip the hogs every month or so during the warm season. The materials which are most frequently used for this purpose are zenoleum, chloronaptholeum, and lime and sulphur. The first two remedies may be used in a solution of three to four per cent. Hogs infested with lice may also be sprayed or dipped in a mechanical mixture of water and kerosene or crude petroleum. Some hog raisers have found a successful device in keeping rubbing posts smeared with crude petroleum. In this way the hogs treat themselves. Hogs may also become infested with kidney worm and various intestinal worms and lung

worms which are usually not of great importance and also with, at least, two parasitic worms which infest man. These are the hog measle worm and trichina. Neither of these parasites, however, is a serious matter in this country for the reason that the habit of eating raw pork is fortunately very limited and both of these parasites are destroyed by the cooking of the meat. In order to prevent the infestation of hogs with trichina it is merely necessary to feed them wholesome materials and not allow them to eat offal and rats around slaughter-houses.

In some localities young pigs may become badly infected with canker sore mouth. This disease usually appears soon after birth and up to the age of six weeks. Blisters appear in the mouth, followed by scabs and ulcers in the mouth, on the jaws, and as the disease progresses, on the head and neck. A good remedy for this trouble has been found in permanganate of potash in a solution in water at the rate of one ounce to a gallon. The solution is placed in a pail and the pig's head immersed for a few seconds, the operation being repeated frequently.

Occasionally considerable difficulty is experienced from sows eating their pigs. This habit most frequently develops in the case of large litters and some breeders believe that a difference is noticeable in the different breeds in this respect. The observations along this line, however, are somewhat unreliable. The causes which are usually mentioned for this vicious habit on the part of sows include keeping them in pens without suitable exercise, use of too much animal food, digestive troubles, constipation and inflammation of the udder. The use of animal food cannot



Courtesy of University of Wisconsin, College of Agriculture.

PIGS FEEDING ON CLOVER—COUNTERPART TO VIEW OF PIGS FEEDING ON RAPE.

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Courtesy of University of Wisconsin, College of Agriculture.

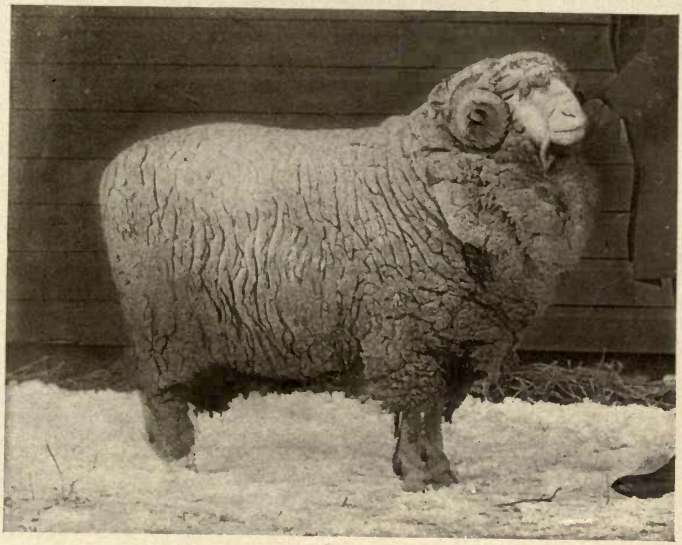
PIGS FEEDING ON RAPE—COUNTERPART TO PIGS FEEDING ON CLOVER.

be an important cause. Many experiments in which large quantities of animal meal have been used have shown that these foods have no tendency to cause sows to eat their pigs. Apparently, one of the chief causes of this trouble is found in the inflammation of the udder or soreness due to the biting of the pigs or to the bruising of the organ upon sticks or other obstacles. At any rate, the habit has often been checked in apparently vicious sows by rubbing the udder with a cocaine solution containing five per cent. of cocaine and lanolin or some other greasy material.

CHAPTER VI.

SHEEP

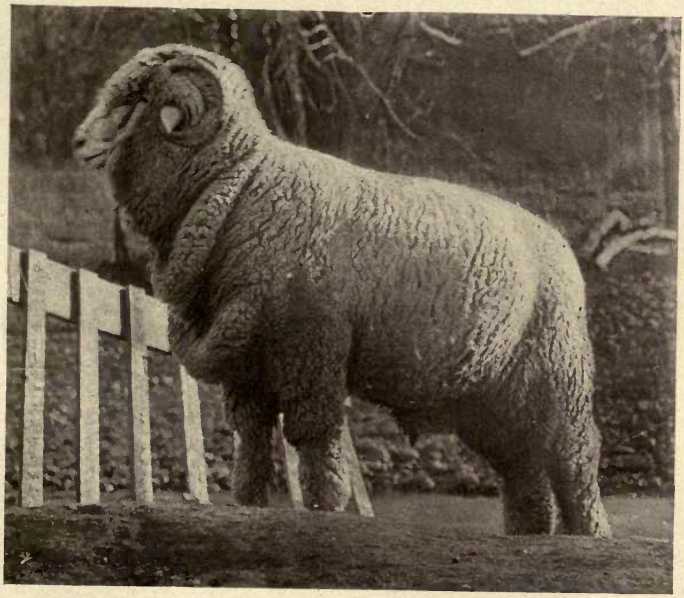
During the past twenty-five years the sheep industry in the United States has been more profitable perhaps than any other line of animal industry, with the exception of pork raising. This is due to a number of causes. In the first place, sheep may be raised under nearly all climates. They withstand cold weather better perhaps than any other domestic animal and are able to care for themselves on the range under what would be disastrous conditions for either cattle or hogs. While it has been often asserted that sheep are not adapted to the general farming conditions of the southern states, recent experiments seem to indicate that fine profits can be secured from sheep raising in Louisiana and the Gulf states. Sheep are raised for two general purposes and accordingly two types have been developed in breeding them, viz., the wool type and the mutton type. These two types have been necessary and have been developed for the purposes of adapting sheep to different climatic and market conditions. Thus, in the eastern states or where the country is thickly settled and a large demand is made for mutton it pays handsomely to raise sheep for the mutton without regard to the value of the wool. Under this system of sheep farming the greatest profits may be made from marketing the



Photograph furnished by H. G. McDowell.

DELAINE MERINO RAM.

This breed produces the familiar Delaine wool.



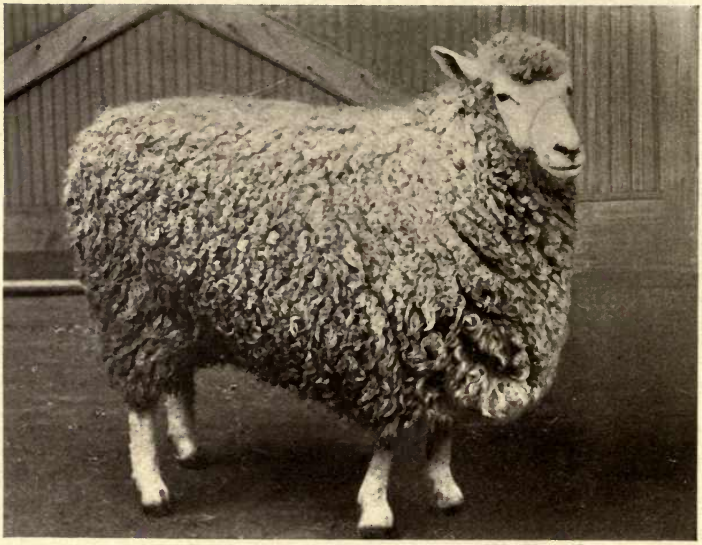
Photograph furnished by E. M. Moore.

VON HOMEYER RAMBOUILLET RAM.

The popular Merino of the range country.

Photograph furnished by E. M. Moore.

VON HOMEYER RAMBOUILLET EWES.



Photograph furnished by F. T. Gibson.

YEARLING LINCOLN EWE—THE WOOL IS AS LONG AS MOHAIR.

wethers at an early age and feeding the old ewes for mutton as soon as they are past the age when they can be profitably kept for breeding purposes. If mutton is the main point for which the sheep is raised the size, form and quality of the meat are obviously the main points sought by the sheep raiser.

On the other hand, throughout the western range states very different conditions prevail with regard to the sheep industry, and this has led to different methods of sheep raising. In general an attempt has been made for many years in the western range states to obtain a sheep which may be referred to as a general purpose sheep. This sheep has been bred so as to produce a fairly good mutton form of reasonable size and at the same time as much wool as is possible with good mutton development. In securing this general purpose sheep, it has been the habit of the sheep raisers throughout the northern and central Rocky Mountain region to breed back and forth, alternately crossing with coarse wool bucks and fine wool bucks so as to prevent the fleece from becoming either too fine or too coarse. For this purpose two flocks of bucks are maintained, usually Lincolns or Cotswolds for the coarse type and Merinos for the fine wool. As soon as the lambs show a too coarse wool they are bred to Merino rams in order to bring the wool of the succeeding generation back to the requisite fineness. Along the Pacific coast and throughout the Southwest and Mexico, the Merino has been the prevailing type of sheep from early historical times and it may be said also that the Merino has recently gained ground in the region where a grade sheep with medium fine wool has heretofore been preferred. The

great prevalence of the Merino in this region is due to the fact that the main purpose of raising sheep in that region is to obtain wool. Sheep men have gradually realized that the greatest profits from sheep under their conditions are to be obtained from wool and not from mutton. The distance of the chief sheep ranges from markets is so great as to prevent the sheep men from realizing attractive prices from shipping sheep to the Chicago market or other sheep markets. To be sure, these sheep may be fattened on the native grasses and sold in the local market, but the demand is not sufficient to encourage a large number of feeders to go into the business.

This may be considered as the usual point of view of the western sheep man. A large number of sheep raisers in the West, however, have come to the conclusion that profits may be made from feeding sheep and shipping them to the eastern markets and these men have actually made good profits from feeding sheep and shipping them on this basis. The majority of the western sheep raisers have agreed, however, that it does not pay to compete in the main markets with the sheep raisers of the East and they have, therefore, settled down to the business of producing wool rather than a high grade of mutton and of considering mutton as a secondary matter in the sheep business. If this view continues to prevail there is obviously little direct competition between the East and the West in the matter of sheep raising, for the West would thus continue to produce sheep for wool and the eastern sheep raisers would continue to feed their sheep on forcing rations, thus, giving them the finest market finish and getting them on the market at times when the

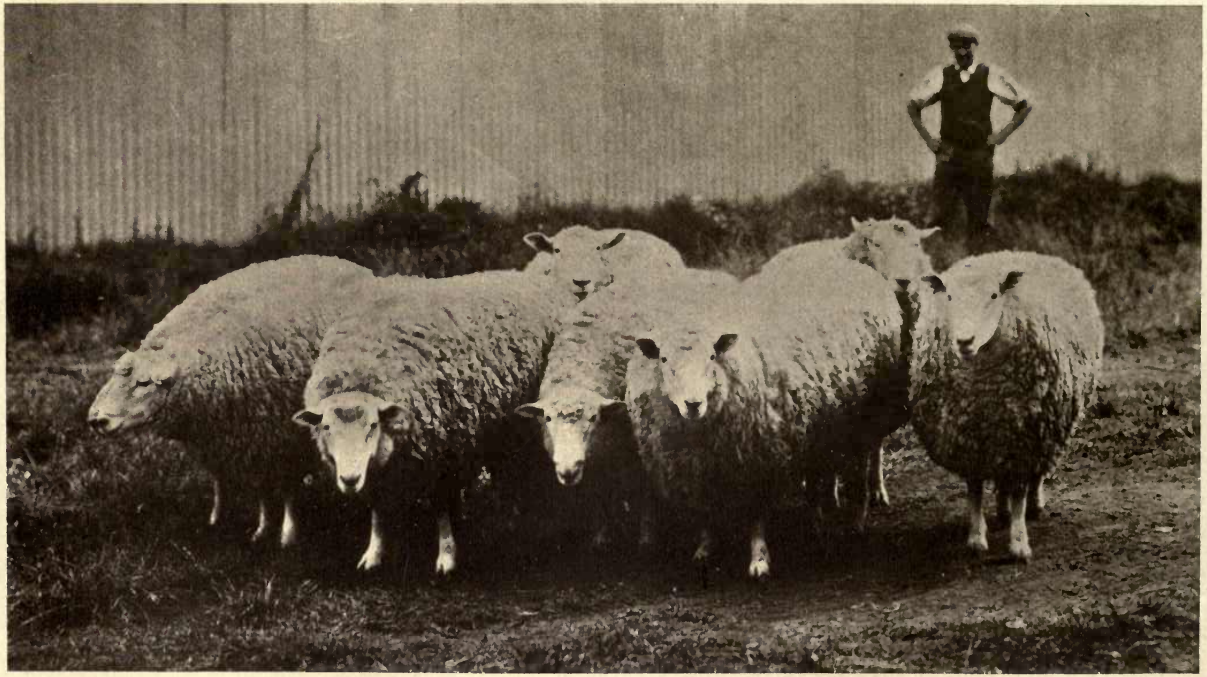
Westerner would really not be in a position to compete.

The business of sheep raising in the western states has been and still is greatly handicapped by range wars and trouble between the sheep raisers and the cattle raisers. This state of affairs has greatly diminished the possible production of the western ranges in both mutton and beef. The grasses of these ranges are of unusual value and nutriment, in fact, they correspond to and even excel the famous blue grass pastures of Kentucky. These grasses, however, cannot be abused without suffering to a greater or less extent and it may be said without entering in much detail into the range troubles of the western states that most of their range lands have been overstocked and their carrying capacity greatly reduced in consequence. If, however, the range is cared for and the grasses given a chance the range may readily be brought back to as fine a condition as it ever showed. In some parts of the range the grasses have not deteriorated to any great extent as the result of grazing. These favorable conditions are usually due to the fact that the men lease the land or have some ultimate claim upon it so that they take an interest in preserving its present condition. On the other hand, so long as the range remains public and everybody's property it is simply a case of being nobody's property and for that reason is treated without any regard to its future condition. It is possible by means of a system of rotation, keeping the sheep on one part of the range in winter and another in summer and not grazing any of the range the year round, to preserve the native grasses in their present condition or even make them more abundant. This

may also be accomplished by collecting seeds of the native grasses and sowing them on the range.

In the following paragraphs some of the characteristics of the chief breeds of sheep with which we have to deal in this country are outlined. In the first place, there are two general types of sheep, the mutton and the wool types. The mutton type as ordinarily understood, includes such breeds as Shropshire, Southdown, Hampshire, Cotswold, Lincoln, Oxford, Leicester, while the wool type is chiefly represented by the various breeds of Merinos. The breeds of sheep are frequently classified according to the quality of the wool. When the classification is made on this basis the coarse-wooled breeds include Leicester, Lincoln, and Cotswold, the medium wooled include the Southdown, Shropshire, Dorset, Cheviot, Suffolk, Oxford, and Hampshire, and the fine wooled breeds various kinds of Merinos. Nearly all of the modern breeds of domestic sheep originated in Great Britain and have found their way to this country and elsewhere from their original home. The chief characteristics of the so-called mutton type include depth, length and regular form of body, a fleece of even length and uniform quality and well formed shoulders and hips. In general, the type of this sheep has been developed so as to give a form in which the fine cuts of mutton are highly developed and in this respect the form of the mutton sheep corresponds in its purpose with that of beef cattle.

Merinos originally came from Spain, but have undergone great modifications in the various countries where they have been distributed. In the United States we have the American Merino, Delaine Merino and Rambouillets. In general,



Courtesy of Division of Publications, U. S. Department of Agriculture.

LINCOLN RAMS, THE HEAVY MUTTON SHEEP.

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Photograph furnished by Geo. McKerrow.

A TYPICAL OXFORD DOWN YEARLING RAM—WITH MEDIUM FINE WOOL AND GOOD MUTTON FORM.

A HOTHOUSE LAMB—BRINGS $15.00 IN JANUARY; IN MAY WORTH ONLY $3.00.

the Merinos are the lightest of all the improved breeds of sheep. They are perhaps more easily adaptable to all kinds of climate and other conditions than any other breed and are excellent grazers but do not mature very early and are somewhat lacking in the quality of the meat. The Merino, as is well-known, produces the finest wool of all sheep and is, therefore, gradually dispossessing other sheep in the region where sheep raising for mutton is not considered profitable. The Delaine Merino is for the most part the American Merino with a larger body. A number of varieties have been developed from this breed, some of which are perhaps destined to become independent breeds. A polled family has been established under the name of the Polled Dickinson Merino. The Delaines are heavier than the American Merino, but somewhat lighter than the Rambouillet. The latter breed is descended from the Spanish Merino and improved by careful breeding and selection. It is now in high favor throughout the western range states on account of its comparatively early maturing quality and great hardiness.

The Southdowns are commonly mentioned first among the improved breeds of mutton sheep, partly for the reason that they are the basis for the development of the various Down breeds of sheep. The fleece is white with a moderate amount of yolk, the face of a brown or gray color, the breast wide, and the general form that of an ideal mutton sheep.

The Dorset has a number of distinguishing characteristics, among them the fact that both sexes bear horns and that the ewes breed at almost any time of the year. They produce a large per-

centage of twins and are among the most fertile breeds of sheep that we have. The Dorset is peculiarly valuable for the production of winter lambs. It is an old breed and has long been kept in a pure form so that its characteristics are firmly established.

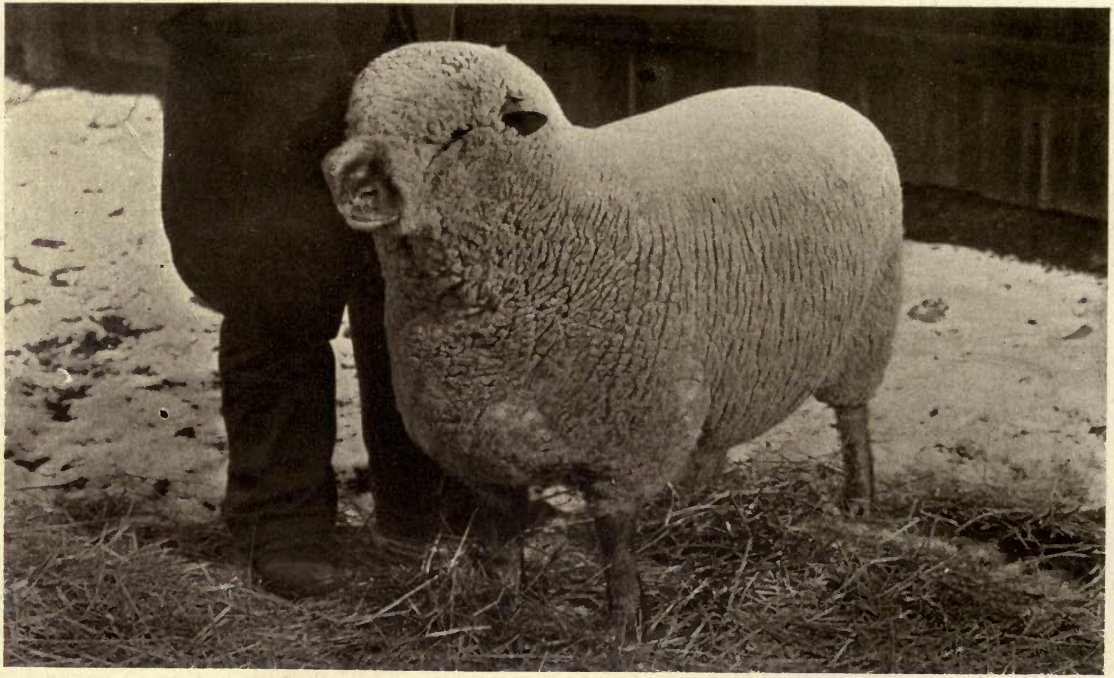
The Shropshire has been considerably modified by selection and breeding within the present century. This breed is not equal to the Southdown or Merino in its grazing ability, but the quality of the meat is excellent and the fleece is of good size and character. The face and legs are of a soft black color.

The Cheviot originated in the hill country of Great Britain and is noted for its hardiness and grazing ability. The quality of the mutton is excellent and the fleece weighs about seven or eight pounds. This breed is especially valuable on account of its hardiness, but at present the number in the United States is comparatively small.

The Suffolk, like so many other breeds, came originally from England and is somewhat larger than the Shropshire or Dorset. The quality of the meat is very fine and the ewes are noted for being good mothers and milk producers.

The Hampshire has been improved by crossing with the Southdown and by careful selection. This is one of the typical Down breeds with black face and legs. It is now widely distributed throughout the United States. The Hampshire are large, early maturing, good rustlers and produce tender and juicy meat. The fleece is heavier than that of the Southdown and the hardiness of the breed is quite satisfactory.

The Oxford has been improved within recent years, especially by crossing with the Southdown, Hampshire and Cotswold. The breed is widely



Photograph furnished by G. H. Davison.

SHROPSHIRE EWE—THE FAVOURITE MUTTON SHEEP.

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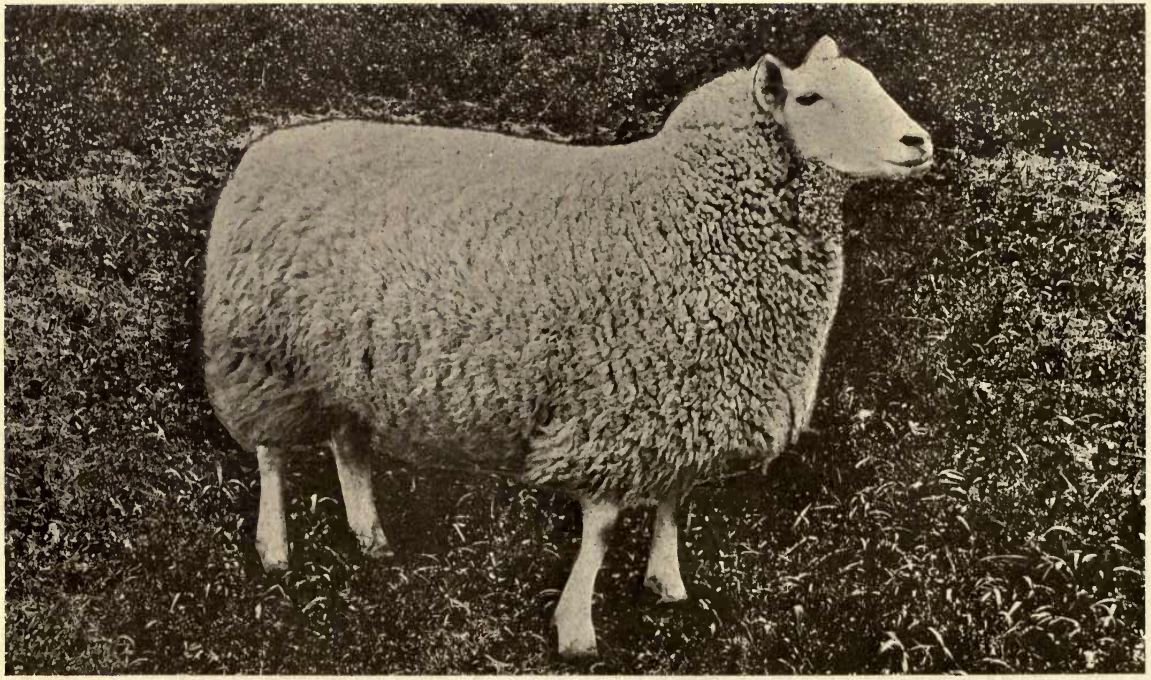

Photograph furnished by F. E. Dawley.

CHEVIOT EWE—COARSE WOOL AND LARGE SIZE.

known in this country and is popular because of its being readily adaptable to all climatic conditions. The quality of the meat is recognized as high and the breed is useful in grading up from ordinary scrub sheep.

The Leicester came from the county of the same name in England and was much improved by the efforts of the famous English breeder, Bakewell, during the middle of the eighteenth century. The Leicesters are somewhat lighter than the other breeds of long-wooled sheep, but heavier than the medium-wooled breeds. They are particularly suited to sections where intensive farming is practiced and mature at a very early age. The quality of the meat is excellent, but they fatten readily and have a tendency to become too fat if forced beyond moderation. The weight of the fleece ranges from nine to eleven pounds.

The Cotswold came from the low, limestone hills of England and has gained great favor throughout the United States since its introduction in 1832. This is the largest breed, excepting the Lincoln and they are equal to the Lincoln in earliness of maturity. The Cotswold, like the Lincoln, is widely used in crossing with the Merino on the western ranges to produce a general purpose sheep of comparatively heavy fleece with fairly good mutton form.

The Lincoln is the largest and heaviest of all breeds of sheep, rams weighing frequently from two hundred and seventy-five to three hundred pounds. This breed is particularly adapted to arable regions with level rather than hilly pastures, but has recently found considerable favor in the range country of the West in crossing with Merinos to give a mutton form to the grade

sheep. The same practice prevails widely in Australia and other countries. The staple of the wool is very long and the fleece may weigh from twelve to fourteen pounds.

There are no such well-defined market classes of sheep as are recognized among beef cattle or hogs. A difference of mutton form, however, must be recognized, but on account of the presence of wool this is not so conspicuous as in the case of beef steers or hogs and is, therefore, judged on a somewhat different basis. It is a fact which has been well established by careful observation of the fattening qualities of different sheep that some sheep are very deficient in this respect, producing a very thin layer of meat over the ribs and without sufficient fat and without proper marbling or mixture of the fat and lean.

GRAINS FOR SHEEP

As with other animals raised for meat so with sheep, corn is to be considered as the king of all grains, but must be mixed with other grains, particularly when fed to young stock or when fed for long periods, in order to secure the best results. Fortunately for the feeder, the economy of corn feeding may be fully utilized in sheep for the reason that the feeding period is ordinarily not so long as with steers. In a ninety-day feeding period the profit from a ration of corn and alfalfa hay is ordinarily considerably less than that from a ration of emmer, barley or wheat with alfalfa in the western range country where corn is not raised in large quantities. The financial outcome of feeding in the corn belt is quite different, for even in Colorado and other range states it has

been found that, when purchased at the same price, corn has a feeding value greater than a mixture of wheat, barley and oats. Emmer in the western states has proved about equal to corn in feeding value for sheep. Among the feeds which may be used with corn, emmer deserves considerable attention. This grain has been found to be worth twenty-seven cents when corn is worth forty cents. Soy-beans as a supplemental feed with corn are of great effectiveness and show a feeding value somewhat superior to corn. Gluten feed, gluten meal and various leguminous hays may also be fed with corn to balance the ration. Pound for pound, however, corn is rather more effective than emmer for sheep. In South Dakota considerable attention has been given to emmer or speltz as it is quite commonly known, and this grain was directly compared with barley. In this test it was found that emmer produced a profit of forty-four cents per lamb during a feeding period of ordinary length, while barley gave a profit of ninety-two cents. The conclusion was, therefore, drawn that emmer is worth about two-thirds as much as barley for feeding to lambs. Throughout all the great grain growing areas immense quantities of screenings are available for use. This material consists of shrunken and broken kernels of wheat together with various weed seeds, depending on the part of the country in which it is grown. Screenings have proven in hundreds of experiments to be a very important grain feed for sheep. In one instance wheat screenings were compared with wheat, oats and barley and a mixture of these grains in a ration containing clover hay as the coarse forage. The screenings proved to be the cheapest and most efficient grain

ration, followed in effectiveness by the mixed grains and wheat, barley and oats in the order given. A slightly greater amount of grain was required in the ration containing mixed grain than when screenings were used and the relative profit was considerably greater since the cost of one hundred pounds of mutton was $1 less with screenings than with the mixed grains.

Soy-beans have been fed extensively to sheep and with excellent results. The amount of grain required for a pound of gain is much less in a ration containing corn and soy-beans than in one containing corn and oats. Wherever soy-beans can be grown successfully they may well be used as a part of the grain ration for lambs and old sheep.

Grain on Pasture.—The question is often asked with sheep on pasture, as with steers and hogs, whether the feeding of grain under such conditions is a profitable practice or not. This matter has been carefully tested by many sheep raisers and by some of the agricultural experiment stations. It appears that the greatest profit is to be obtained when sheep are kept on pasture sown especially for them. This system of sheep raising enables the farmer to maintain a much larger number of sheep with the same area of ground and also makes it possible to supply the sheep with a succulent ration for a longer period than could be done on ordinary unimproved pasture. Among the crops used for this purpose we should mention winter rye, oats, peas, barley and oats, and rape. By this means the farmer may keep the pasture capable of maintaining a large number of sheep for the whole growing season. Where the feeding of grain has been tested with sheep maintained even on the best of pasture it appears that the

Photograph furnished by A. W. Smith.

LEICESTER EWES, CANADA—A PAIR OF PRIZE WINNERS.

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Courtesy of Division of Publications, U. S. Department of Agriculture.

WELSH MOUNTAIN SHEEP PRODUCE MUTTON OF UNUSUAL DELICACY.

gain in lambs is from fifty to sixty per cent. greater when they receive a half-pound of oats, barley or some other similar grain than where no grain is fed. The additional increase made by the use of grain is worth much more than the cost of the grain used in obtaining it and is, therefore, to be recommended from a financial standpoint. The use of cultivated pastures of the sort above described is to be highly commended, since if sheep are kept on native pasture or prairie grass or other less nutritious grass the increase in weight is liable to be seriously checked as soon as the grass becomes dry in the fall. In the range region proper the native grasses are more nutritious when dried up in the fall than are some of the more recently introduced species of grass. The growth of sheep, however, is not satisfactory on such pasture without grain. In a comparison of various grains fed to sheep on pasture, the grains stood in the following order in the economy of mutton production; whole corn, corn and bran, whole macaroni wheat, whole hard wheat, ground macaroni wheat and bran, whole emmer and ground emmer.

With regard to the amount of grain which it is desirable to feed to sheep, it should be remembered that only a light grain ration is necessary to produce an excellent finish in lambs when legumes are available. For example it has been found that one-half to three-quarters of a pound of grain per head per day is sufficient to put a fine market finish on sheep fed during a period of seventy to ninety days with plenty of alfalfa or clover pasture. The grain ration, however, even when legumes are fed as roughage should be maintained throughout the whole feeding period rather than toward the latter half of this period.

It is not necessary to import grain from other states or to send away long distances for milling feeds. The ordinary farm grains such as are grown on every farm may be utilized in lamb or wether feeding when they are mixed in the right way and with suitable roughage. Thus, a mixture of corn and oats, corn and peas, or corn, peas and oats will produce rapid gains in lambs at a handsome profit. It is not necessary to feed these grain mixtures in larger quantities than three-quarters of a pound per day, together with such roughage as is ordinarily present on the farm. In a comparison of various grain rations for sheep in Wisconsin, it was found that one containing equal parts of corn, oats and bran with silage and hay is exceedingly satisfactory for ewes. A very efficient ration was found in equal parts of shelled corn, oats and brewer's grains. The feeding of brewer's grains has one advantage over corn and corn and oats in that among other effects it produces a larger milk yield in ewes and, therefore, produces the rapid development of the lamb. If the condition of the ewes and the growth of the lamb are both considered as the purpose of feeding a grain ration, brewer's grains and corn silage stand high in effectiveness. In another comparison of grains for sheep feeding brewer's grain stood at the head, followed by bran, shelled corn and oats. Any one of the grains, however, was quite satisfactory when fed in connection with two and one-half pounds of silage and two pounds of hay per day for each ewe. As in previous tests dried brewer's grains and corn silage were most effective in increasing the milk yield of the ewes. The sheep raisers frequently ask the question whether it is more profitable to feed grain extensively from

birth until the lambs are ten to twelve months old, or from weaning time until the market finish is completed or merely from the beginning of winter until the end of the feeding period. As a rule, it is found that lambs fed grain from the earliest age at which they will eat it produce better results than those which receive grain only during the fattening period. Lambs fed grain during early life become accustomed to it and make more economical use of grain than those which receive it only in forcing rations when the fattening period is begun. In some tests of this sort the curious fact has been developed that occasionally corn makes more economical gains than other grain mixtures even for a period of ten months. Lambs fed on an exclusive ration of corn, however, would not be fit for breeding purposes, since their vitality is considerably weakened by the lack of protein in the ration.

The above discussion of grains for sheep has not included all of those which may be fed to sheep, but it should be remembered that the most important ones ordinarily are corn, barley, wheat, oats, peas, emmer and some of the milling products like middlings, gluten meal, cotton seed meal, etc. Cotton seed meal has not been fed extensively to sheep for the reason that other less expensive nitrogenous feeds may be readily obtained in the North and the southern states have thus far not done much feeding of sheep for mutton.

COARSE FEEDS FOR SHEEP

At the head of the list of coarse feeds for sheep we must place alfalfa. This does not indicate that alfalfa is always and everywhere the most effective coarse feed which can be used in fattening

sheep, but that it is actually used to such an enormous extent throughout the western states where the sheep business prevails most widely that it justifies placing it at the head of the list. Alfalfa may be used as the exclusive fattening ration for sheep with merely the addition of a small quantity of roots. This practice prevails among many sheep men of the western states who have found it possible to put a tolerably fine finish on lambs or even old sheep by feeding them alfalfa ad libitum with small amounts of mangel-wurzels or sugar beets for a period of seventy to ninety days in winter. The profits derived from feeding alfalfa hay under such circumstances are well worth considering, since a ton of this hay will produce at least $7 to $10 worth of mutton in localities where it can be purchased for $5. The feeding problem when nothing but alfalfa hay and roots are used is reduced to its simplest terms and the cost of managing sheep under such conditions is very slight.

It has been demonstrated that while alfalfa may be depended upon to bring sheep to a fairly good mutton form by the addition of grain, the greatest profit is, nevertheless, to be obtained in feeding small amounts of grain and sugar beet pulp with alfalfa. The best method of doing this is to feed the beet pulp ad libitum as well as the alfalfa hay and a small quantity, say one-half pound per day per head of grain. When such a ration is used a pound of mutton can be produced on one and one-half pounds of grain, four pounds alfalfa and ten pounds sugar beet pulp. The cheapest grain to feed in this ration in the western states has been found to be wheat screenings. It has also been shown by various farmers that good

results can be obtained from feeding sheep nothing but alfalfa and straw. The gains which are made on this ration are economic and the quality of the mutton is good enough to command high prices on the local markets.

A reaction has set in in many of the western markets against the overfed and excessively fat lambs which have been brought to market during the past few years. If lambs are placed in the feeding pens in a fairly good condition they may be brought to the right finish in from seventy-five to one hundred days by the addition of a small grain ration with alfalfa hay fed ad libitum. Lambs will yield good returns on either native grass or alfalfa hay in connection with a small grain ration. In a series of comparative tests alfalfa produced twenty-seven per cent. greater gains, one thousand two hundred and eighty pounds more mutton per acre and one and one-half per cent. more dressed weight at fifteen per cent. less expense than native hay. In this test it appeared that the value of alfalfa hay for mutton feeding purposes was about $17 per ton.

Brome Grass.—In those parts of the western states where brome grass has been cultivated extensively it has proved to be a valuable feed for lambs and old sheep. Where this grass has been sown on the range it starts up in the earliest spring and, therefore, yields succulent forage in advance of the native grasses. The hay under favorable condition also produces large yields and has been shown to be more nutritious than timothy hay or prairie hay for feeding lambs. When lambs receive brome grass hay, less grain is required for a pound of gain than on timothy or prairie hay. Clover of various kinds is also fed to lambs and old sheep with the best results. In the eastern and middle

states this hay takes the place of alfalfa in the sheep ration of the western sheep man. Red crimson, alsike and white clover have been fed to sheep with satisfactory results. In one comparison of alfalfa with red and alsike clover both kinds of clover produced slightly larger gains in lambs than alfalfa and the amount of alsike clover and red clover required for a pound of gain was slightly less than the amount of alfalfa required for the same amount of gain. Clover hay may also be fed in the place of cereal or grain hay where this material is considered a standard feed for sheep. In one comparison of clover hay and grain hay lambs gained seven pounds per month on clover and five and one-third pounds on grain hay. The amount of clover eaten for each pound of gain was fourteen pounds and of grain hay eighteen pounds. In some tests the cost of producing one hundred pounds of mutton on clover was $1 less than that when grain hay was used.

Cowpea hay has been extensively used for feeding sheep, especially in the southern states where this crop is grown most widely. It compares favorably with other coarse forage for both lambs and old sheep. In fact, in some localities where coarse forage and grain are exceedingly expensive it has been found that about the only way to obtain suitable profit from fattening sheep is by the use of cowpea hay. This reduces the amount of grain necessary to give a good market finish and may itself be produced very cheaply in the southern states. According to the ordinary state of the market it cannot be considered as higher than $5 a ton.

Pea pasture is one of the favorite sources of feed for mutton. Many varieties of field peas have been

used for this purpose from Canada to the cowpea region and from the Atlantic to the Pacific coast. In the San Luis valley, Colorado, a special industry has grown up in the use of pea pasture for lambs and old sheep until at present about three hundred thousand sheep are fattened annually on this, the sheep being allowed to harvest their own food. Sheep are quite successful in collecting shattered peas in the field after the crop has been harvested and peas as a grain are everywhere recognized as an important part of the ration for sheep. The whole material is, therefore, well suited to this purpose. In some parts of the western states where peas are needed for seed or may be sold at too high a price for lamb feeding, pea straw is used as a feed for sheep. This also gives good results as shown in numerous experiments by farmers and in tests carried on by experts in animal industry. The great importance of Canada field peas is apparent from the variety of conditions under which it makes a successful crop. Thus, as already stated, it not only grows throughout a wide stretch of latitude, but thrives well at all altitudes from sea level to nearly eight thousand feet. At high altitudes in Wyoming it was found that even with a poor crop of peas the total yield was two thousand pounds of which one thousand three hundred pounds was vines and seven hundred and forty pounds grain. It is a frequent mistake among farmers who utilize pea pasture for sheep to allow them to run over the whole pasture from the start. Some of the plants are thus trampled down and soiled and are, therefore, refused by the sheep so that a considerable percentage of the crop is wasted. Pea pasture may best be utilized by hurdling the sheep on small areas of the field and moving the fences

from time to time. The average gain of lambs fed on different rations in Wyoming showed that the most effective ration was one containing alfalfa, turnips, corn and linseed meal, while a ration containing nothing but field peas was almost equal to it and various other rations were far less effective. Field peas, even when used alone, are thus seen to be a fine ration for sheep. There is no use in putting scrub lambs on expensive feeds. They cannot be fattened in a short period and the growth is not sufficiently rapid to allow any profit to be made. The only way to secure a good profit from high-priced feeds is to use the very best quality of lambs and sheep which can be obtained. In one test with pea pasture sixty lambs maintained themselves for one hundred days on eleven and one-half acres of field peas, which were raised without irrigation. The lambs harvested their own crop, made more rapid gains and went to market in a better condition than those which were fed in pens on alfalfa and grain.

While all kinds of roots may be fed to sheep with good results in increasing the effectiveness of the ration the most extensive tests have been made with sugar beets and sugar beet pulp. In the first place, the sheep feeder should not expect too high returns from the use of roots as a food for any animal. Their effectiveness as already indicated is largely to give succulence and palatability to the ration. Sugar beets in different experiments where the value of all feeds was carefully noted have shown an effectiveness indicating a feeding value of from one and one-half to three dollars a ton, depending upon the time of the year and quality of the sheep. Beet pulp may nearly always be obtained for a much lower price than sugar beets, and is nearly

as effective as the latter. It is, therefore, indicated as a valuable food for producing mutton. In states like Colorado it is considered that the purpose of the farmer in feeding lambs is to obtain a profitable market for his surplus alfalfa, sugar beet pulp and home grown grains. Even when sugar beet pulp gives only one-half the mutton production which is secured by sugar beets its use is, nevertheless, cheaper than that of sugar beets on account of the much lower market price. Beet pulp is a very useful material for feeding with alfalfa, especially during the early part of the fattening period. The mutton produced on beet pulp has an excellent flavor, but is ordinarily not very fat unless some grain is fed with it. In Colorado and neighboring states, lambs may be made to produce mutton very cheaply on sugar beet pulp and alfalfa with a small ration of wheat, barley or corn. The feeding value of sugar beets, however, is not so high as sometimes supposed. If sugar beets can be sold for $4.50 per ton at the factory it does not pay to feed them to lambs. It should not be supposed that sugar beet pulp or sugar beets themselves can in any sense replace alfalfa in the lamb ration. They should simply be used as a supplemental feed in such rations. Since sugar beet pulp contains about ninety per cent. of water it is evident that there is less than two hundred pounds of actual feeding material in a ton and in feeding experiments a ton of sugar beet pulp has proved to be about equal to three hundred pounds of corn. It is too bulky, however, to feed in large quantities and when fed to excess produces soft mutton. In order to feed it to the best advantage it must be fresh and this means that it cannot be transported long distances. About four pounds per day is a sufficient ration for lambs which should

also receive nine ounces of corn per day or similar rations of barley or wheat. The whole feeding value of sugar beet pulp and alfalfa cannot be obtained, except by the addition of some grain to the ration. From the experience of feeders in Utah, it appears that the best plan is to feed pulp ad libitum together with a ration of alfalfa and mixed grains. As an example of the effectiveness of such a ration, it has been found that one pound of mutton is produced from one and one-half pounds of corn, ten pounds of pulp and seven and one-half pounds of alfalfa hay. It appears to be advisable when sugar beet factories are offering reasonable prices to sell the sugar beets and buy back the pulp, since in this way a greater profit will be obtained from the crop of sugar beets than if the beets are directly fed to sheep. In a series of comparative tests of different rations, sheep which received only alfalfa and sugar beet pulp made the smallest gains per day, but gave the largest profits on account of the cheapness with which these materials can be produced. Much faster gains and a better finish were obtained by adding grain to the ration.

In localities too far removed from sugar beet factories to obtain this material in a fresh condition the beet pulp may be used in the dried form. When dried and in good condition it keeps for long periods and may be managed so as to give good results in mutton production. In some tests dried beet pulp and corn have proved to be about equal in feeding value for sheep. When dried beet pulp is mixed with grain the effect is very striking in the rapidity of gain and in the fine market finish of the mutton.

Sheep as Weed and Brush Exterminators.—The general usefulness of sheep about the farm is quite

well understood, but on many farms they are not managed in a way to secure all the good which can be obtained from them. Thus, sheep will make a large amount of mutton at no cost for feeding material when allowed to graze on weeds about the fence corners in corn fields and similar situations and in brush lands. The forage thus obtained may not give an excellent quality to the meat, but the sheep easily maintain themselves without expense to the farmer and at the same time are a benefit in cleaning up the land. Moreover, on stubble fields sheep pick up enough of the scattered grain to make a very satisfactory gain and to produce a good quality of mutton. Whenever sheep are confined entirely to brush for their forage they are likely to get poor and young lambs will not make the best growth. The use of such material for sheep is suggested merely to show the possibilities of the sheep's foraging powers and is not to be recommended to farmers who desire to produce standard mutton for finicky markets. This has been demonstrated to the complete satisfaction of thousands of farmers who have tried it. Brush pasture can be used for a part maintenance ration of stock sheep during the summer, but cannot be considered as desirable for fattening fine mutton sheep. The conditions are somewhat different in the range states where some of the weeds and native grasses obtained are extremely nutritious and capable in themselves of making sheep as fat as the market could require. Some sheep raisers, however, maintain that mutton produced on such forage is not quite equal in flavor to that raised on various grains, including corn.

The value of cow's milk for lambs is a point of considerable practical importance. On all large

sheep ranges it is customary to bring up on the bottle a large number of lambs which fail to get owned or which become motherless through the death of the ewe. These lambs, which the sheep men call "bums," are by no means pitiable objects after they have been cared for in the pens or about the farm houses and fed at regular intervals on cow's milk from a bottle. The successful use of cow's milk in producing a uniform rate of gain in lambs depends upon its being given to them at frequent intervals while they are young. The relative merits of cow's milk from the bottle, ewe's milk from the bottle and ewe's milk directly from the ewe has been tested in a number of experiments. It appears, in general, that lambs which suck the ewes make more satisfactory gains than by any other method of obtaining milk. If fed large quantities of ewe's milk from the bottle, however, they lay on flesh in a very rapid manner. Satisfactory gains are also always obtained from the use of fresh, wholesome cow's milk. Thus, in a comparison of cow's milk and sheep's milk, this did not appear to exercise any great influence on the lamb. The fat content of ewe's milk is nearly twice as high as that of the cow, but the lamb does not appear to miss the fat in the cow's milk.

Rations.—As is apparent from the above brief discussion of rations used in fattening sheep a great variety of satisfactory rations may be compounded for this purpose. These rations vary in different parts of the country according to the ease and economy with which different feeds may be obtained. For example in Utah, Colorado, Idaho and other Rocky Mountain states an excellent ration may be prepared from sugar beet

pulp, alfalfa, and wheat screenings. It must be always remembered in compounding rations that the margin of profit is small even under the best conditions and may be easily destroyed entirely unless the feeding value of the ration and the market price of the different feeds be carefully borne in mind. Thus, in the region where alfalfa and sugar beet pulp may be conveniently obtained eight pounds of alfalfa and seventeen pounds of beet pulp will produce a pound of gain. The same amount of mutton will be made by sheep for every six pounds of alfalfa and four pounds of wheat screenings eaten. Even in a region where the price of the latter is high, it is possible to produce gains in lambs for less than four cents a pound with rations of alfalfa, sugar beet pulp and wheat screenings.

In the corn belt, corn should naturally constitute one-half or more of the grain rations, since this may be produced the most cheaply of all grain feeds and is exceedingly effective in mixing with peas, wheat or barley. In the Southwest, corn may be partly or wholly replaced by Kafir corn and in the South by sweet potatoes or other starchy roots. It is always best, however, to feed a certain amount of highly nitrogenous grain such as barley, wheat or peas and this mixture constitutes the mainstay of the sheep raisers among the Canadians, where corn is not produced extensively and has a relatively higher market price.

Water.—It is important to provide a clean and sufficient water supply for sheep at all times and especially during the fattening period. Sheep will gain more rapidly when they have constant access to water than when they are watered only once per day. The cost of gain is also less with

a running water supply. On the range the sheep have different requirements in regard to their water supply. They may need water twice a day, once a day or every third day according to the character of the food. In some of the desert ranges where the only green plants are of a succulent nature, it has been found possible to maintain sheep successfully without watering oftener than once in two or three weeks. In the winter on the desert ranges advantage is taken of the fact that localities which have no surface water supply whatever may be safely grazed on account of the presence of small quantities of snow. The sheep eat snow whenever they are dry and thus obtain a sufficient supply of water in a clean wholesome condition. Under ordinary circumstances there is no advantage whatever in warming water for lambs or old sheep in winter.

Feeding Range Lambs.—While it is entirely true that many of the larger western sheep ranches decline to feed any of their sheep, saying that it does not pay to attempt to compete with the eastern sheep raisers on the mutton market, nevertheless the practice of feeding western sheep on the ranges where they are grown is gradually increasing. The profits obtained from this practice have been so flattering in many instances that the feeding of range lambs has become an extensive business in localities where it is well-suited and where the necessary grain feeds are convenient. In Montana and many other localities sheep are put in a fairly good condition without grain by merely feeding a ration of alfalfa hay and roots. The sheep rancher finds that every year he has a certain percentage of surplus sheep, some being wethers and some old ewes which he

must turn into mutton. He must, therefore, face the problem of whether these sheep and lambs are to be sold to the feeder or whether they are to be shipped East and sold at a very low price, on account of their poor market condition, or whether he should go to the extra expense and extra risk of putting a market finish on such animals. This matter has accordingly been thoroughly tested in many of the range sheep states. In Idaho it has been found that by the means of clover, pea hay, whole oats, and such roots as mangels and carrots or with small quantities of silage an excellent quality of mutton may be produced on range sheep. At times there may be little profit in such feeding, judging from the actual cost of the gain on range sheep, but the profit is always relatively great if we stop to consider the low price which ranchmen would otherwise have to accept for the range sheep. Not only in the Pacific Northwest and the northern Rocky Mountain states, but also in the Southwest the feeding of range sheep has been found to be a profitable industry and has given added impetus to methods of range improvement, cultivating every foot of ground upon which water can be turned. In all of these western range states the surprising fact has been true within the past year or two and is still true in many localities, namely, that mutton is produced, sold on the hoof and shipped to the eastern markets, after which it is brought back again from the packing houses. There is absolutely no business sense in such a procedure. The local markets in the range states are quite sufficient for the fine mutton that can be produced at present and if the practice of feeding range sheep at home increases beyond

the limits of the local markets the large central markets are available for such sheep and at remunerative prices, as shown by a number of experiments along this line. If the ranchman can raise large quantities of alfalfa he will find no way of securing so large a price for it as by feeding it to lambs, since they will return from $7 to $15 per ton in localities where the market price of alfalfa is not above $5.

The same problem of what to do with range lambs has come up before the sheep raiser of South Dakota and has been solved in the same manner. He has found it desirable to feed his lambs on local grains such as emmer, macaroni wheat, and barley together with liberal rations of alfalfa, clover or other forage plants. In certain localities of Utah the local market for mutton is already supplied and during the past eight years it has been found more profitable to feed lambs for the eastern markets than for the local market. It seems to be the practice of the local dealers in Utah to regulate the price of lambs by the prevailing prices in the central markets, subtracting the estimated cost of the transportation. This estimate is, however, frequently put so high that the western feeder has found it to his advantage to prepare to put the finest possible finish on his lambs and ship them East in direct competition with the eastern sheep feeders. The range lamb does not usually suffer in this competition and the practice is therefore increasing. The same story comes from Wyoming and other parts of the range country where a really serious effort has been carried on by men who have made a study of the requirements of sheep and the demand of the market regarding the quality and form of mutton.

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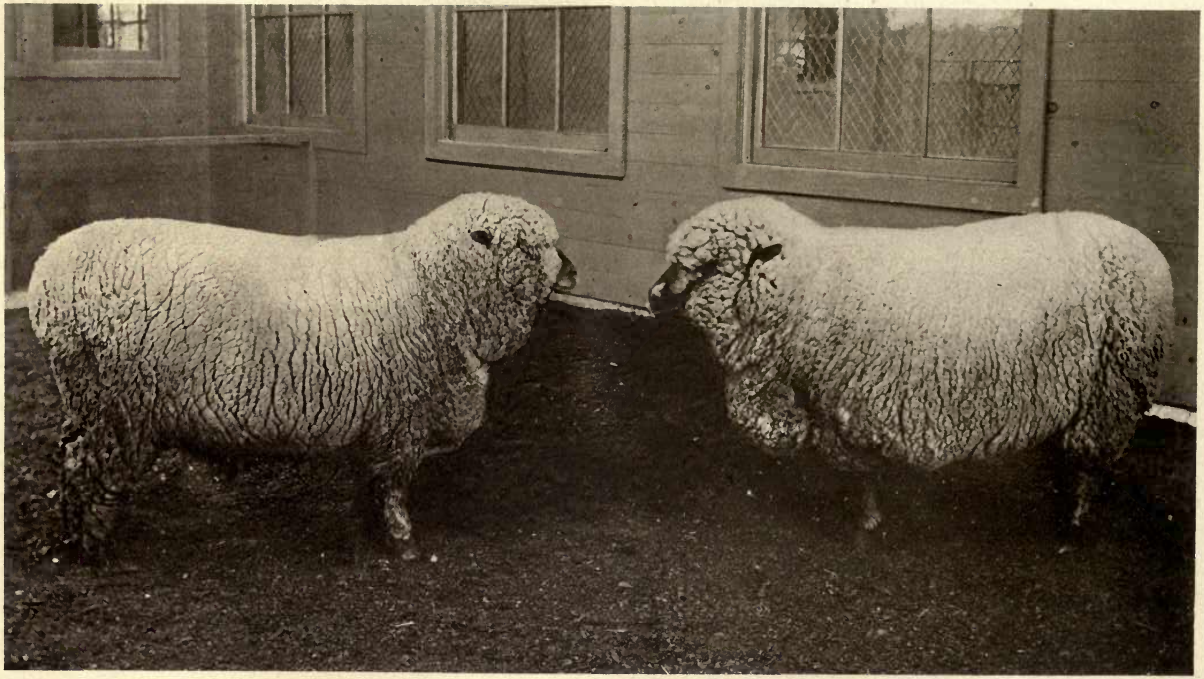

Courtesy of University of Wisconsin, College of Agriculture.

A PAIR OF SECOND CROSS SHROPSHIRE-MERINO YEARLING WETHERS.

Crossing is much practised with sheep.

CROSS-BRED DORSET-SHROPSHIRE — USED FOR THE PRODUCTION OF WINTER LAMBS.

Sheep in the South.—Much difference of opinion prevails regarding the practicability of raising sheep in the far South. The question has often been decided in the negative by farmers without looking for any experimental results or without testing the matter for themselves The widely prevalent belief is that sheep cannot thrive in hot countries and this has been the end of the matter in so far as the average farmer is concerned. There are actually many difficulties in the way of sheep raising in the South, but they are not so serious that they may not be overcome. Thus, pure breeds imported from the North often yield but meagre profits to the southern farmer. This may be due to the great change of climate and environment, but it is frequently due to the unusual prevalence of stomach worms. The long warm season of the southern states renders this a large and a much more serious problem than in the North where it is serious enough. In fact, while the stomach worm is the most serious trouble of the sheep industry east of the Mississippi River, it is a particularly difficult problem to cope with in the South. The infestation with parasites, however, may be largely overcome by the intelligent use of pastures, frequent changing of the sheep as often as twice a week from one pasture to another pasture and in localities where the pest is particularly bad, keeping the lambs in bare lots and feeding them on green feeds during the season when the parasites are worst. Excepting for the prevalence of parasitic worms, however, sheep do not suffer from other troubles any worse than in the North and there appears to be no reason why the sheep industry should not be more extensively developed in the South that it is at present.

The Cost of Gain.—The actual expense incurred in putting a pound of gain on lambs or old sheep depends primarily on the cost of the grain and almost equally on the skill of the feeder. It is frequently true that the cost of a pound of gain during the fattening period is equal to the price per pound finally secured for the sheep when sold in a finished market condition. At first thought, this would indicate that the feeding had been done at a loss, but this is quite untrue as should appear upon a little consideration. In fact, the same condition appears everywhere with all kinds of farm animals. The cost of gain is almost always apparently obtained at a loss. It should be remembered, however, that the market value of the whole carcass is increased by putting on a fine finish. While, therefore, the price obtained for the gains produced during the fattening period may not be more than what the same amount of meat cost in feeding the lamb, yet the increase in value in the rest of the carcass is sufficient to make the whole process of fattening a profitable one. In general, the cost of gain in lambs under the prevailing conditions and managed in a skillful manner should range from three and a half to four and a half cents per pound. It may actually run much higher than this, but so long as five, six or even seven cents a pound may be obtained for live sheep in a fine market form there is sufficient profit for the feeder to incur this expense.

The Milk Yield of Ewes.—Ordinarily, the ewe yields milk for from four to six months and then dries up, whether the lamb has been taken from her or not. It is a matter of interest to determine the amount of milk yielded by ewes. This is obtained

by weighing the lambs immediately before and after sucking the ewe. By this method it has been found that ewes yield from thirteen and a half to sixteen pounds of milk per week or from two to two and a half pounds per day. Occasionally ewes yield as high as three pounds per day. Obviously, the amount of milk yielded by the ewe is an important matter in determining the growth of the lamb during his early life. The lamb with a heavy milking mother has an advantage over his less fortunate comrades which cannot easily be overcome by subsequent care and feeding.

Another matter of importance is to determine the best treatment for ewes before lambing in order to obtain the most vigorous lambs and a large milk yield. It has been found that feeding a ration consisting of one-half of a pound of equal parts bran and oats per day for about two weeks before the lambing period is a very satisfactory feed so far as the physical condition of the ewes is concerned. The lambs, however, are not so vigorous and the milk yield is inferior to that obtained when corn stover or silage is fed and one-half of a pound of bran and oats per ewe daily. Ewes do not thrive so well on oats and hay as on silage and hay. Corn stover, however, almost universally gives excellent results. When corn stover and corn silage are fed together roots may also be added to the ration with good results in the condition of the ewe and the milk yield.

Ewes carry their lambs from one hundred and forty to one hundred and fifty-six days, the usual period being from one hundred and forty-four to one hundred and fifty days. The longer period given by French authorities is due to the fact that their figures are based largely on Merinos which

mature more slowly than the large mutton breeds. The other breeds do not differ much in the length of the period of gestation. There appears to be a slight difference in the period of gestation in the case of large and small lambs, large lambs being carried somewhat longer. The different breeds show a difference in the vigour of the lambs at birth. Thus, seventy-eight per cent. of Southdown lambs are what would be called strong at birth, while the percentage in cross bred Shropshire and Merinos is seventy-three and in Dorsets sixty per cent. Single lambs are larger at birth than twins and twins than triplets, the average difference in weight between single and twin lambs being about one-half of a pound, yet the twins usually make as good gains by a stated time after weaning as single lambs.

The Milk of Different Breeds of Sheep.—Some importance attaches, as already indicated, to the quality and quantity of the milk and in this respect the breeds of sheep vary somewhat, the amount varying in different breeds from one and six-tenths pounds to four and five-tenths pounds per day, according to actual weighing tests. In these comparative tests Southdowns gave the least and Dorsets the highest. Considerable difference has also been noted in the content of fat in the milk of different breeds. Thus, the cream or fat of sheep milk varies from five and eight-tenths per cent. in Shropshires to eight and four-tenths per cent. in Dorsets. As a rule, Dorsets and Southdowns excel other breeds in milk supply when the lambs are young.

The Weight of Lambs at Birth.—The size of the lamb at the time of birth depends largely on the ewe. The heaviest lambs come from the heaviest

ewes and the weight of the lambs and the ewes vary together. The breed and size of the ram appear to have little to do with the weight of the lamb. Ram lambs, however, are about fifteen per cent. heavier than ewe lambs and make slightly more rapid gains, at least, during early life. As already hinted the weight of twin lambs averages about one-half pound less than the average weight of all lambs, and the amount of gain for the first two months is greater in lambs having the heaviest weight at birth. A comparison of the weight of Merino, Shropshire and Hampshire lambs in Missouri showed the average to be at birth seven and seven-tenths pounds for the Merinos, seven and eight-tenths pounds for the Hampshires, and eight and four-tenths pounds for the Shropshires, while the average birth weight of lambs from ewes weighing ninety pounds was seven and two-tenths pounds, from one hundred pound ewes seven and four-tenths pounds, from one hundred and ten pound ewes seven and five-tenths pounds, from one hundred and twenty pound ewes seven and nine-tenths pounds, and from one hundred and thirty pound ewes eight and three-tenths pounds. As just hinted, the weight of male lambs at birth exceeds that of female, averaging eight and one-tenth pounds for males and seven pounds for ewes with an average for both sexes of seven and six-tenths pounds. Likewise the average weekly gain in ewe lambs is three and nine-tenths pounds and in ram lambs four pounds. The average weight of single lambs of all sexes is seven and eight-tenths pounds and of twin lambs seven pounds.

Winter or Hothouse Lambs.—Nearly all sheep are bred in the fall and thus bring the lambs in late spring. The ordinary practice of allowing the

rams with the ewes in November makes the lambs come in May. By the time these lambs are fit for market the demand for young lambs is not very great and if they are held over until the winter market opens they are too old to command the highest market price. It is highly desirable, therefore, from a business standpoint, to secure ewes which will breed in the spring or early summer so as to mature the lambs for the winter market, just after the holiday poultry season is closed. For the purpose of winter sheep production the Dorset and Hampshire sheep are the best adapted, but the Dorset is unquestionably the best. This sheep can be made to breed at any season of the year and even twice in a single year. The latter practice, however, is hard on the ewes and is not to be recommended for the average farm. Moreover, the Dorset produces twin lambs in about thirty-nine per cent. of cases and, as already indicated, give enough milk to force these twins to early maturity. In the production of winter lambs it is, therefore, best to depend on the Dorset tendencies of early breeding and twin lambs. It is not necessary to purchase outright a whole flock of Dorsets, but if a Dorset ram is bought and bred to ordinary sheep, the grade ewes thus obtained will breed earlier than their mothers, in fact, in some cases they will breed as early as pure Dorset ewes. At any rate, the second crossing on these grade Dorset ewes will produce ewes which for all practical purposes in early lamb raising are equal to Dorsets. In some respects, the grade ewes thus obtained are superior to the pure bred ewes in hardiness and in form. Moreover, some markets demand black-nosed lambs and these can be secured in grades, while the pure Dorsets have white noses. The best results

in breeding up grade ewes for early lambs have been obtained from crossing Dorset rams on Merino, Shropshire or Coltswold ewes. The demand for winter lambs is rapidly increasing after having first originated in some of the large eastern markets. At present the supply is hardly equal to the demand although the prices paid for such lambs are very attractive. Thus, lambs at a weight of fifty or sixty pounds and in prime condition may be sold for from $3 to $18, depending on the quality of the lamb and the time at which he is marketed. Such prices cannot be obtained for lambs if kept several months longer, although in the meantime they have gained considerably in weight.

The vigour of the sheep, and climatic conditions, must be considered in this business. While it is possible to get Dorsets to breed at any time, in practice there are certain seasons which are far better than others. Thus, if the sheep are bred in May or June they will bring the lambs to the finest market condition during the holiday season when the highest prices will be realized. Winter lambs are marketed at the age of about two months and at this time, as already hinted, should weigh about fifty pounds.

In order to force winter lambs to the finest appearance, it is desirable to give the ewe a rather heavy grain ration to increase her milk yield. While the Dorset gives a larger quantity of milk than other sheep they, nevertheless, require milk producing foods in order to keep up this flow. For this reason the grain ration should be liberal and should be helped out by the use of roots, silage or soiling crops like alfalfa, clover, rye, or by a good pasture. Moreover, the lambs should be taught to eat grain at the earliest possible moment. They

will begin to eat grain at the age of four weeks if encouraged, or even somewhat earlier, and will gradually increase the size of their grain ration during the remaining month until they reach a proper market finish. A test was made of crossing Dorsets on Merino and Shropshire ewes in Wisconsin in which it appeared that the first cross Dorsets would breed before the ninth of July and drop their lambs by the middle of November. While it is, therefore, true that the first cross ewes are ordinarily ready to breed at the right time for securing winter lambs there is more certainty of early breeding in the second cross of Dorset rams on native sheep. It should not be supposed that ordinary ewes will breed any earlier to a Dorset buck than to any other kind of sheep. The tendency to early breeding may be transmitted from the rams, not to the native ewes, but to their cross-bred offspring and to the subsequent lambs obtained by using a Dorset ram to the cross-bred sheep.

The production of winter lambs is a specialty which requires skill and experience and should not be gone into headlong without some previous knowledge of the business. One advantage beside the profit to be gained from raising winter lambs is that in regions where the stomach worms are very bad, lambs which come in the late fall are largely spared the risk of infection, especially in the northern states, whereas lambs which come in May are almost sure to become infested during the summer months. This does not apply to the same extent in the far South where the growing season extends nearly the year round, but in the northern states the infestation with the stomach worm takes place almost always in the summer and consequently if lambs come in November they need not be

allowed on pasture at all, since they naturally do not eat anything but the mother's milk for about one month. At the end of that period practically all danger of infestation with stomach worms is past.

Likewise, in Minnesota it has been found by a long series of careful experiments that the breeding habit in ewes which ordinarily drop their lambs in the spring may be changed so that they will produce them in the fall or early winter. This change is effected in practice by crossing with pure bred Dorset rams for two or three generations. It appears that after the changed breeding habit has been brought about in the ewes a superior quality of lambs, at least, in many instances, may be obtained by using rams of a black-faced breed, for example Southdowns or Shropshires.

Lambs vs. Wethers.—As with all other farm animals, including chickens, so with sheep, the rate of gain is greater in young than in old animals and the cost of gain is less. This difference is sufficiently great to affect the financial results in breeding sheep in a pronounced manner. For example, in Montana it was found that the cost of feeding per day in lambs was one and two-tenths cents and in wethers one and five-tenths cents while the cost of a pound of gain in lambs was four and five-tenths cents and in wethers six and three-tenths cents. These differences, while very slight in a single sheep, become a large factor when it is multiplied by thousands as is the case on large sheep ranches. In a subsequent test of this matter in Montana it was found that the cost of producing one hundred pounds of meat on lambs was $4.18, on one-year-old wethers $5.83, on two-year-old wethers $5.90 and on old sheep $6.78. These differences in cost were due

to the fact that the amount of food required for a pound of gain increases regularly with the age of the sheep. On account of the more rapid growth in young lambs than in older sheep it is desirable to feed more grain, particularly of a nitrogenous nature. As a rule, it will be found desirable to feed grain to lambs to the extent of twenty-four per cent. of the ration, to one-year-old wethers to the extent of fifteen per cent. and to two-year-old wethers to the extent of fourteen per cent. The amount of shrinkage in making long shipments to market is about the same in lambs, yearlings and two-year-old sheep, but is considerably higher in very old sheep. In order to reduce the amount of shrinkage in shipment as much as possible, it is desirable not to feed sheep too heavily during the early part of the trip.

Grades vs. Scrubs.—We find again in sheep the same question regarding the relative merits of pure breeds, grades and cross bred animals as compared with scrubs. There can be no question whatever regarding the superiority of pure breeds or animals containing a considerable percentage of pure blood as compared with scrubs, providing always that corresponding care and attention is given to the superior quality of animal. For example, it has been found in Colorado that Shropshire lambs make better gains than common western lambs when given the same ration. Thus, during a feeding period of ordinary length Shropshire grade lambs gained forty-three and five-tenths pounds while native western lambs gained only thirty-one pounds. In fact, it has been shown beyond question that it is folly to feed high-priced grains and forage plants and give expensive care and attention to common scrub lambs or sheep,

since the expense of such operations cannot be covered by the price obtained for the scrub lambs.

Exercise.—While in actual experiments to test the value of open lot and pen feeding for sheep, somewhat contradictory results have been obtained there seems to be little reason to question the proposition that sheep of all sorts require some exercise other than what they can obtain when housed or penned too closely. The results secured in testing this matter in Wisconsin were not always the same in different years, sometimes being in favor of exercise and at other times in favor of non-exercise. As a rule, however, the best results have been obtained in practice from allowing sheep considerable freedom, even during the height of the forcing period. In order to make a success with sheep it is necessary to start with vigorous lambs, since otherwise they will not thrive and cannot make an economic use of their food. The strength of the lambs depends in turn on the care and management of the flock in winter. As shown by experiments in Minnesota one of the most common mistakes in sheep management and one which always brings disaster in its wake is to keep sheep in too warm and close quarters. Sheep are covered with a heavy coat of wool in winter and readily endure any ordinary degree of cold without harm, provided they have dry places in which to lie down. On the other hand, crowding in close quarters with the temperature too warm and the air too moist causes the sheep to sweat. The best results are commonly obtained in allowing sheep in open yards even in the coldest days of winter with a protected place in which they may lie in time of cold rain storms.

Shrinkage in Shipment.—It has already been

stated that the shrinkage in shipment is practically the same in lambs and old sheep. The ordinary shrinkage for a railroad journey of one thousand five hundred miles is about eight per cent. of the live weight. This may be depended upon as the average, which will be observed in sheep from the age of six months to three years.

Mutton Production of the United States.—An idea of the importance of the sheep business from the standpoint of mutton production may be obtained from the statement that about eighteen million five hundred thousand sheep and lambs are annually slaughtered in the United States with an average carcass value of $4.25. The number of sheep slaughtered annually amounts to about thirty-eight per cent. of the total number which are kept on hand. It should not be supposed, however, that variation in the number of sheep in the country depends entirely on the demand for mutton or on the market price obtained for mutton sheep. There are other more important factors in this variation. The most important is naturally the price of wool. Recently, as is generally known wool has been high and the profit derived from the sheep business has been correspondingly great.

In order to give a definite idea of the relative importance of wool and mutton on the western ranges, where the greater part of our sheep production takes place, it is only necessary to state that a general tendency prevails toward the development of a fine-wooled, heavy-fleeced sheep without much regard to the mutton form. Careful accounts kept on a large sheep ranch in Montana for the past twenty-five years show that by far the greatest part of the profit in sheep comes from wool. This statement, of course, presup-

poses that the market price of wool is reasonably good. Thus during the past few years on the ordinary Montana and Wyoming sheep ranch it has cost $1.60 per head per year to feed and care for sheep under conditions where a considerable amount of land is cultivated to forage crops and a large percentage of the grazing land owned or leased. The value of the fleece averages about $1.25 and the value of the mutton about seventy-five cents per year for all of the sheep maintained on a given ranch. This does not mean that the average price of a mutton sheep is seventy-five cents but only a certain part of them can be sold in a given year for mutton so that of a total income of $2 which may be taken as the average for all sheep on the ranch only seventy-five cents of it is to be credited to mutton while $1.25 comes from wool. Incidentally these figures show an average profit from sheep under the conditions mentioned to be about forty cents per head per year or where the expense of feeding and care are normal this is twenty per cent. on the money invested or a clear profit of four per cent. on the total invested capital. The sheep business is thus seen to be, as at present managed, a reasonably profitable one.

The Treatment of Lambs.—Unless the lambs are to be sold for mutton at the age of two or three months it is best to dock the tails and castrate all ram lambs excepting such as are to be preserved for breeding purposes. Both of these processes should take place at the same time and ordinarily when the lambs are from ten to fourteen days of age. The tails of blooded stock of great value may be docked by the use of a hot pinching instrument especially devised for this purpose and

the cut surface may then be treated with a proper antiseptic and the lamb watched to guard against inflammation or irritation by flies. On the western sheep ranch, however, such a process would occupy altogether too much time. The ordinary foreman of a sheep ranch is capable of docking the tails of about two thousand lambs and castrating the ram lambs, which average one-half of them, in the space of two and one-half to three hours, whereas, by the process of using a hot pinching instrument the same number of lambs would require several days work. The ordinary practice on the western ranches is to have several men catch the lambs and place them before the operator in the proper position. The tail is cut off by one stroke of a sharp knife and the ram lambs castrated without any attempt to use antiseptics or other precautions to prevent accidents. As a matter of fact the loss as a result of this process is very slight and need hardly be considered.

Shearing.—On small farms where only a few sheep are maintained shearing does not constitute a serious proposition and the time occupied in shearing each sheep is naturally much longer than is the case on a large ranch. The common practice is to tie the legs and place the sheep on a table or in a trough in order to assist the operator in holding the sheep. As a rule, the old-fashioned sheep shears are still used although hand machine clippers are gradually being introduced and are favorably reported on by a considerable percentage of those who have tried them. On the western sheep ranges the shearing is done by men who follow this business as a profession and work at it the year round. These men shear in Australia and Argentine Republic during our winter season

and then travel into the North Temperate Zone with the advance of spring, so that their work, as just indicated, continues the year round. In the United States they begin shearing in Texas and Arizona and New Mexico in early spring, January or February, and gradually travel northward, completing the season's work in Montana and British Columbia in June and July. On these large ranches the shearing machines are coming into greater and greater favor. The clippers are connected by means of flexible or jointed rods with a long shaft providing power for twenty or thirty or even more clippers, depending on the extensiveness of the business. A good sheep shearer averages about one hundred sheep per day and the record made with hand shears is the same as with the machines. Such men are capable of shearing sheep either by the machine or by hand in about four minutes. The advantages in favor of the machines are that the sheep is sheared somewhat closer, is cut less and more wool is obtained. Most men who have tried both methods find that from three-quarters to one pound more wool is obtained by the machine clipper than by the hand shears. At first it was thought that sheep clipped closely by machines would be subject to sun scald but such has not been found to be the case.

Sheep Scab.—This is the most serious disease of sheep throughout the western range country. The disease is due to the attack of a small mite which burrows under the skin and causes irritation and shedding of the wool in the infested patches. The presence of the mite causes intense itching and this in turn causes the sheep to rub on anything convenient and this tears out the wool and leaves

the fleece ragged. The first sympton of the disease is observed in the sheep rubbing and they should immediately be investigated to determine whether the mite is present or not. This disease is readily transmitted from one sheep to another, so that it spreads with considerable rapidity throughout the flock. There are two forms of scab, the body scab being the most serious and the head scab, caused by another mite, which confines its attacks largely to the head and neck. The prevalence of scab on the western ranges became such a serious matter that the Bureau of Animal Industry undertook its eradication on a large scale and began the dipping of sheep in the worst infested states. In this work several million sheep have been dipped in the states of Utah, Wyoming, Idaho, Oregon and elsewhere and the work has been attended with very satisfactory results. Sheep scab has been thoroughly checked and practically exterminated in Wyoming and excellent progress has been made in other states. The immense importance of this work can only be appreciated by those who have seen scabby herds of sheep and have realized the immense loss which this disease caused, not only in wool, but in the weight of the sheep. The treatment adopted by the Bureau of Animal Industry and the one which has been the most generally effective consists in plunging the sheep into a mixture of lime and sulphur while warm. The essentials of a good dip are that it should kill the scab mite in the skin, injure the sheep as little as possible and cause no damage to the color of the wool or the quality. Tobacco dips are effective, but sometimes discolor the wool. Occasionally objections are made against the lime and sulphur dip that this material injures the staple of the wool,

but such injury has not been of a serious character. The chief objection to the lime and sulphur dip is that it requires some time and attention to make it, but this is not a serious matter where there are thousands of sheep to be dipped. The proportions commonly recommended are twenty-four pounds of sulphur, eight pounds of lime in one hundred gallons of water, the whole mixture to be thoroughly boiled and maintained at a temperature of one hundred and ten F. while the sheep are immersed. None of the dips commonly recommended for sheep can be safely used in a strength sufficient to kill the eggs of the mite. They only kill the mites of different ages. It is therefore, necessary in the case of scabby sheep that they be dipped a second time after an interval of about ten days. The reason for this is that during this interval all the eggs which were not destroyed by the first dipping will have hatched and the young mites will thus be destroyed.

Stomach Worms.—Mention has already been made of the stomach worms in the southern states. This small worm which lives in the stomach of sheep, goats and calves and is not over three-quarters of an inch long and about like a hair in diameter, causes a most serious disease of sheep throughout the country from the Mississippi valley eastward and north and south. It begins to make its effect visible in May and in nearly all cases where lambs are unthrifty and show a dry papery skin during the summer they are infested with stomach worms. The examination of the stomach of one of these animals will show the presence of the worms. A number of good remedies have been devised for stomach worms, but there is the serious objection against all of them that

the operation is altogether too tedious. If a large number of lambs are affected at the same time it is almost impossible to give each one a drench of any medicine several times. In the sheep business, as in some other lines of animal industry, it is necessary from a financial standpoint to be able to apply remedies on a large scale in case of an outbreak of infectious disease. This is possible with scab since dipping vats may be constructed of such size that from three thousand to fifteen thousand sheep may be run through in a day. The remedies commonly used in treating stomach worms are turpentine at the rate of one part in sixteen parts of milk and given in doses of one to three tablespoonfuls, or one tablespoonful of gasolene in four ounces of sweet milk, or coal tar creosote in doses of two to four ounces of a one-per-cent. solution in water. The same treatment may be given to goats or calves.

The best way of controlling the disease, however, consists in a frequent rotation of pastures so as to prevent any pasture from becoming too thoroughly infected. In this way the lambs may be kept from becoming infected by eating grass soiled with the droppings of other infested sheep.

Lung Worms.—In the lungs of sheep another parasitic threadlike worm occurs which causes coughing and sneezing and a discharge of mucus from the nose. The skin becomes exceedingly papery and gives rise to the name paper skin for the disease. The treatment for this trouble as usually recommended consists in driving the lambs into a small closed space in which they are forced to inhale irritating fumes. This causes violent coughing which assists in expelling the worms. Another treatment to be given in connection with

this consists in injecting a mixture of olive oil and turpentine into the windpipe. This remedy, however, suffers from the serious objection that it takes altogether too much time and the best way to control the disease is by the use of preventive measures, such as are recommended for the stomach worm.

Sheep occasionally become affected with a sort of blood poisoning as a result of cutting with dirty shears at the time of shearing. The disease runs a rapid course and is characterized by swellings and intense inflamation near the cut part. There is no cure for this disease but the trouble may obviously be prevented by the use of clean shears.

All sheep are subject to liver flukes which cause the so-called liver rot. This flat parasitic worm is also taken into the stomach on grass eaten along the edges of ponds. Attention should always be given to the condition of waterways in pastures in which sheep are kept in order to prevent infection by these parasitic worms for most of them are acquired by eating soiled grass in pastures.

Similarly with the common tape worms of sheep which sometimes occur in such numbers as almost to obstruct the passages in the intestines as well as in the bile ducts of the liver. These parasites are also taken into the stomach on grass infested by a young form of the tape worm which comes in turn from infested dogs. This indicates the desirability of keeping all useless dogs out of sheep pastures and of treating for tape worms all dogs which are used for herding sheep. The best vermifuge for use in expelling tape worms from sheep is the areca nut which may be given in doses of one to three drams.

Sheep are also attacked by a parasitic worm

which burrows into the walls of the intestines and causes nodules, giving rise to the name nodular disease for this trouble. This disease is more serious in the South than in the North, but occasionally occurs as far north as New York. No medicinal treatment is of value in ridding sheep of this disease. The whole trouble must, therefore, be controlled by preventive measures. Lambs may be kept on bare lots where there is no grass for them to eat. They may then be fed green crops in racks, taking care to remove all of the material that is left after each feeding. There is little likelihood of the lambs becoming infested under such circumstances, even if the intestines of the ewes are badly attacked by this parasite. The bare lot method has been tested with considerable success in Louisiana and has the practical value that ewes which are infested may thus be kept for breeding purposes without danger of transmitting the parasites to the lambs. This is of course, an important matter since if it were not possible it would be necessary to get rid of all the infested ewes or, at least, they could not be utilized for breeding purposes.

The gid worm has not been definitely known to occur in the United States until within the past few years. A few cases have been found in Montana and it may be possible that the disease is more widely spread than is thought. This disease is a serious one in sheep in Europe and is due to an immature form of a tape worm which lives in dogs. The disease is thus transmitted from dogs to sheep and this furnishes another reason for keeping close watch of all dogs about the sheep pasture. The immature tape worm when taken into the stomach of the sheep penetrates through the tissue to the surface of the brain, where it develops in a sac

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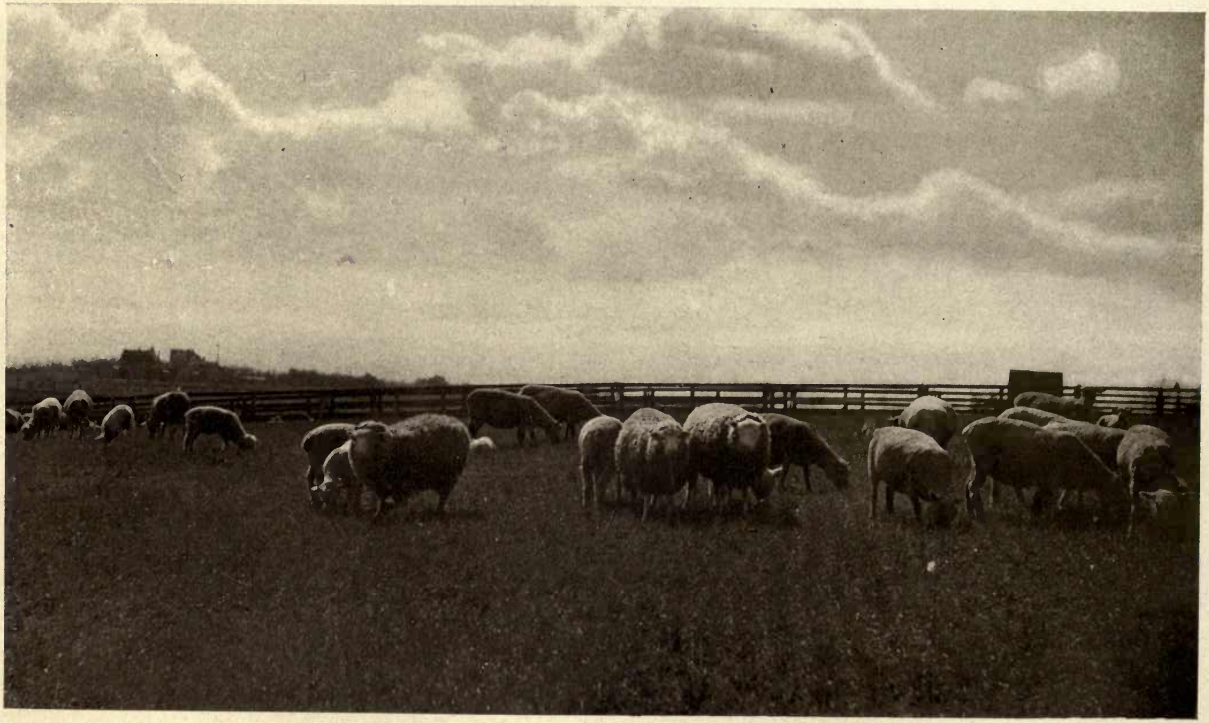
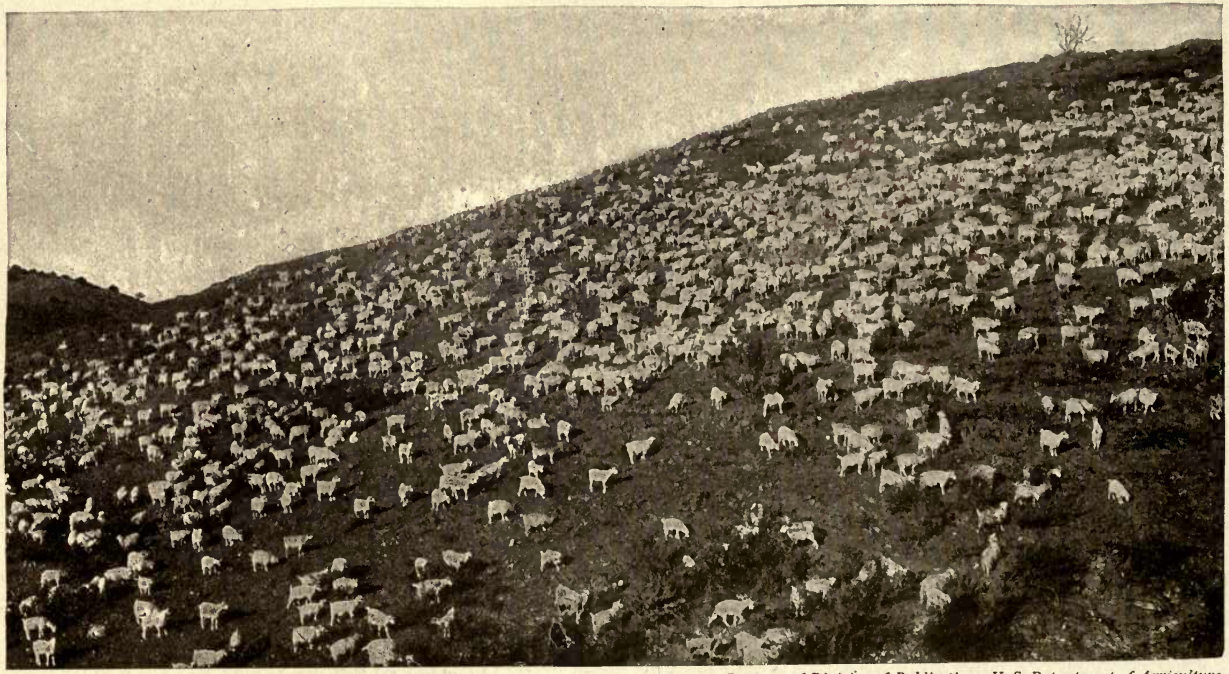


SHEEP PASTURING ON RYE—IT FURNISHES AN EARLY GREEN FEED IN SPRING.



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A HERD OF ANGORA GOATS GRAZING ON SCRUB OAK, ARIZONA.

containing a fluid. The pressure on the brain causes a curious and characteristic symptom in the infested sheep. The animal keeps turning around to the right or left according as the parasite is located on the right or left side of the brain. There is obviously no remedy for this disease and prevention is again the only hope of eradicating it.

The sheep bot fly lays its eggs within the nostrils of the sheep where they develop into maggots and cause serious irritation and worry to the sheep. Some sheep raisers have found considerable success in preventing the fly from laying its eggs by smearing the sheep's nose with tar or some other substance of a disagreeable odor. In many cases the maggots may be removed by a direct application of turpentine in the nostril with a feather.

It is necessary to dip sheep annually and sometimes more than once a year not only on account of the sheep scab, but also on account of infestation with the sheep tick. This is a peculiar insect which lives on the skin of the sheep and when occuring in large numbers causes great loss of flesh. It may be destroyed by the same dips which are recommended for sheep scab. The best time to dip sheep for this purpose is immediately after shearing, since at that time the dip readily gets in contact with all the ticks which may be in the short wool.

CHAPTER VII.

GOATS

Goats have always been raised to a greater or less extent in this country, but in the past eight or ten years a considerable increase in interest in the goat business has been stirred up by the efforts of the Bureau of Animal Industry and of others who have helped to develop goat raising in the United States. According to recent statistics there are about two million goats in this country of which perhaps seven hundred thousand are Angoras, the rest being common goats. These goats are distributed quite unevenly throughout the country but occur in every state and territory. Texas stands at the head with more than six hundred thousand, followed by New Mexico, Alabama, Oregon, California, Georgia, Mississippi and other states. During the recent revival of interest in the goat industry, particular attention has naturally been given to the Angoras, which with other improved breeds, together with the common goat, are considered to be descendants of a common wild species. The Angoras were first introduced into this country from Turkey during the administration of President Polk. The Angora goat and common goats are valuable on account of their ability to clear brush land and derive a maintenance ration from leaves, bark, small twigs, weeds and other waste materials which would

scarcely be eaten by any other farm animal, excepting sheep. It is claimed that when Angoras are allowed to graze on such material the meat takes on a gamey flavor and, in fact, some demand has arisen for Angora meat which is sometimes sold under the name Angora venison. The chief value of the Angora is for the production of mohair which constitutes the greater part of their fleece. Mohair is extensively used in this country in the manufacture of plush and a large percentage of it is imported. Some coarse hair or kemp is usually mixed with the mohair in our Angoras and this indicates impurity of the blood.

The weight of the fleece in three-quarters bred Angoras is one to one and a half pounds, worth about fifteen to twenty cents a pound, while seven-eighths goats shear two to three pounds and fifteen-sixteenths bred goats three to five pounds, worth from thirty to forty cents a pound. Occasionally, of course, much higher, weights of fleece have been obtained, the weight sometimes reaching sixteen pounds. This, however, is very exceptional. The skins of Angoras with the mohair attached and properly tanned are in considerable demand for rugs either in a natural color or dyed. Such skins may be used for rugs or robes. Another purpose for which Angoras are used by the ranchers of the West, is as a leader for a herd of sheep. Many sheep raisers consider it advisable to have a goat with each band of sheep, since, goats travel more rapidly than sheep, are not so easily frightened and are more likely to assume the initiative in looking after good grass. The band is thus prevented from tramping about too much on the same area, therefore, injuring the grass and failing to obtain the best grazing.

The common goat is rather more hardy than the Angora, but even the Angora is capable of maintaining itself under most conditions where sheep thrive. Thus, they are raised under all climatic conditions from Alaska to the tropics. Goats are more active grazers than sheep and travel over greater distances. If they are to be confined they require a good quality of fence. On the western ranges the herders sometimes find that a horse is required, since herding on foot becomes a more difficult business than herding sheep in the same way. Under eastern conditions and where the rainfall is heavy some protection is necessary for the goats to prevent them from becoming too badly soaked with water and a little pretection from the sun during the hot season is desirable. While, as already indicated, goats are capable of picking up a living on what would otherwise be called waste material they do not always thrive under such treatment and they naturally respond like other farm animals to suitable feeding. It is not necessary, however, to go into the subject of the feeding of goats much further than to say that goats can be fed the same feeds and in the same proportion as recommended for sheep.

The young kids for two or three days are exceedingly delicate and must be cared for attentively. The best time for the kids to come is in the early spring when the leaves are just starting on the bushes. For some time after the kidding season the young must be left in the corral every day while the does go out to graze. Kids are not hardy enough to stand travel. They may be kept in ordinary corrals or may be kept tied in open sheds. Goats are weaned at the age of five months

and the buck kids that are not intended for breeding purposes should be castrated at ten to twelve days of age. An Angora herd may be bred up from common goats by the use of a pure bred buck. It is commonly considered that five crosses of this sort produce an animal about as good as the average so-called pure bred Angora obtained in this country. The cost of producing a small herd of Angoras is, therefore, not very large. Goats are sheared once or twice a year according to the climate, twice in Texas, New Mexico and Arizona, in March and September, and once in the northern states. The mohair is removed by hand shears or by clipping machines, as is the case with sheep.

It is often stated that goats are practically immune to the diseases which attack sheep and that the business of raising goats is, therefore, comparatively safe. Such, however, has not been found to be the case. Goats are very susceptible to stomach worms as a number of men who have engaged in the industry have found to their cost. They are also subject to tuberculosis to a slight extent, notwithstanding the fact that they are commonly said to be immune. Recently a serious disease broke out among goats in this country and was thoroughly studied by the Bureau of Animal Industry. This disease is called takosis and is exceedingly fatal to goats. What is still worse, there is no satisfactory remedy for this disease, so that the goats are rapidly carried off when the disease breaks out in a herd and the owner stands in a helpless condition. Fortunately takosis seems to be somewhat less prevalent during recent years than in the past.

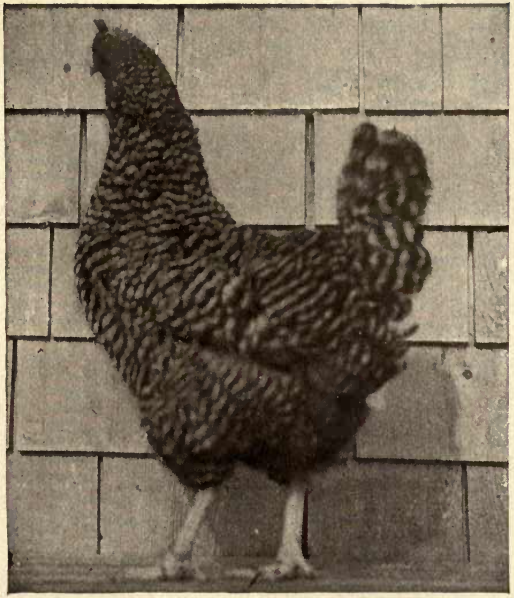
Recently there has been a revival of interest

in this country in milch goats and this interest has been further stimulated by the importation of a number of Maltese milch goats. The advantages of goats for milk production are that the milk is claimed to be excellent for children and invalids and for cookery, that it is comparatively free from tuberculosis and that it can be produced very cheaply. The milch goat yields from one to four or five quarts a day, but three quarts is a good average even under the best conditions. In chemical composition goat's milk contains a little more fat than average cow's milk. The odor of goat's milk is not very disagreeable, except in case some of the filth from the goat should fall into the milk. The period of lactation of milch goats is about seven months, but may occasionally be somewhat longer. The milk of goats may be carried to consumers by the same methods as are adopted for cow's milk, or as is the case in some countries the goats may be driven along the street and milked as demands are made. Goat's milk has also been used to some extent in the manufacture of cheese and butter. The price ordinarily obtained for goat's milk is twelve to twenty-five cents a quart and this high price is partly due to the scarcity of the article and partly to the belief that goat's milk is practically sure to be free from tuberculosis.

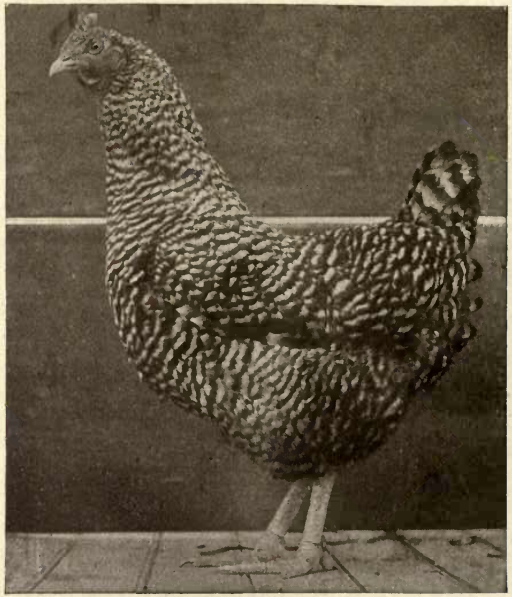
The size of the Angora goats which were first brought to this country was rather too small. At present an attempt is being made to increase the size and individual animals are found which weigh from one hundred to one hundred and eighty pounds. Some pains is also being taken in breeding to produce heavier fleeces of a long staple. In managing goats it has been found advisable to train dogs

especially for the work. In some parts of Texas a goat dog has been developed by crossing collies and the ordinary hound. This produces a dog of considerable intelligence, speed and size. While many good points have been brought out in raising goats in this country and considerable interest stirred up in the business, there seems to be not the same good business reason for raising goats as for raising sheep. In most localities where sheep thrive they will yield more profit to the owner than goats. It is a particularly difficult and tedious process to work up a regular demand for an unfamiliar product. Customers are scarce, the article is comparatively little known and the average individual does not know what to do with it, so that considerable hesitation is felt in buying it. This is to some extent the case with goat's milk. Then, too, we have to consider the fact that the use of goats in the production of milk under ordinary eastern conditions, at any rate, is a far more expensive procedure than the maintenance of dairy cows. It may be fairly assumed that a goat will eat one-fifth as much as a cow. The productiveness of the average dairy cow, however, is far beyond five times that of the goat. Moreover, in so far as freedom from tuberculosis is concerned cow's milk may be readily rendered safe by sterilization, pasteurization, clean methods, the use of healthy cows or even by the use of formalin as recently recommended by Von Behring. In putting these strictures on goat raising, it is not intended to discourage any one from entering into the business, but simply to call attention to the fact that goat raising does not always prove profitable and at best only in the hands of skilful men who have had some experience in this line

of business. There is always more demand for the improvement of those lines of animal industry which are already well developed and for increasing the productiveness of those animals upon which we already depend than in introducing and popularizing animals with which we are relatively unfamiliar.



THIS HEN LAID 8 EGGS IN A YEAR—HER ANCESTORS WERE POOR LAYING STOCK.



Courtesy of Maine Experiment Station.

THIS HEN LAID 251 EGGS IN A YEAR—SHE INHERITED HER LAYING QUALITY FROM HER ANCESTORS.

PLYMOUTH ROCK HENS.

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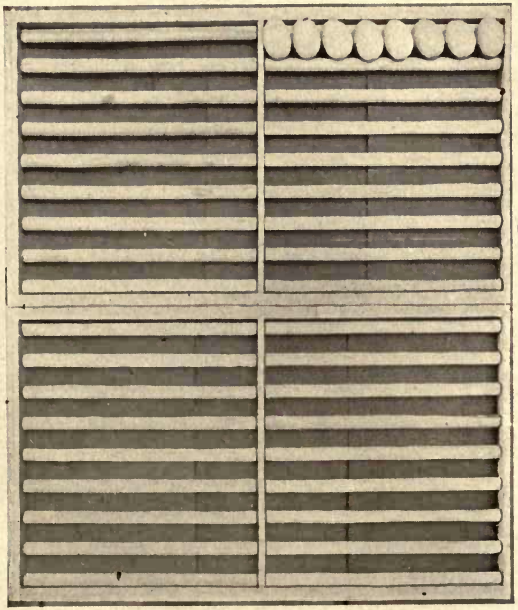
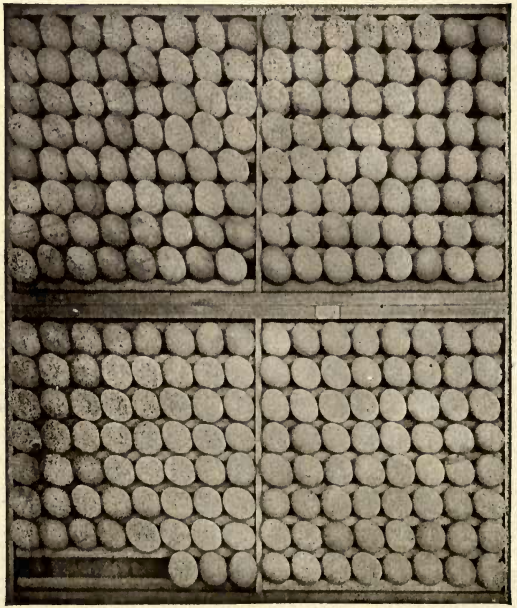


TOTAL ANNUAL PRODUCTION OF ONE HEN, SELECTED FROM POOR STOCK.



Courtesy of Maine Experiment Station.

ANNUAL YIELD OF ONE HEN, SELECTED FROM A LAYING FAMILY.

COMPANION PIECE TO THE TWO PLYMOUTH ROCK HENS.

CHAPTER VIII.

POULTRY

The immense value of poultry is hardly realized by those who have paid no attention to the statistics relating to this matter. Nearly every farmer and a large proportion of the inhabitants of small towns and some even in cities raise poultry to a greater or less extent. The total number of birds thus kept for home use is probably considerably greater than the estimates furnished by the Census. According to the most recent figures the total number of chickens in the United States is 233,600,000, of ducks 4,807,000, of geese 5,677,000, and of turkeys 6,600,000. The number of Guinea fowls has not been separately estimated but is probably not less than 500,000. The American hen produces annually about 1,294,000,000 dozen of eggs valued at $144,000,000 besides an annual crop of chickens for meat valued at $137,000,000. The amount of money invested in the poultry business is therefore quite sufficient to entitle this to a position in the front rank of the lines of animal industry. The annual international poultry trade at present amounts to $300,000,000 of which $100,000,000 is in eggs. It is apparent, therefore, that chickens and other poultry not only occupy a large place in the home and on the home markets but also in international trade.

The difference from a financial standpoint be-

tween the poultry business and other lines of animal industry is that as a rule the raising of poultry is carried on purely as a side line and without much attention to the business details of the matter. For this reason it happens that a considerable percentage of those who raise poultry are unable to say anything definite concerning the profit and loss side of the business. Perhaps a larger number of people have failed to make a success with poultry than in the case of any other line of animal industry and this fact indicates clearly, that while it is possible for almost any one without the exercise of any care or of common sense to raise some poultry, it is not possible to make a business success of the matter without giving attention to all the necessary matters including the health and food of fowls but also to market conditions and to all known points which relate to the business. In other words, poultry, raising, like other lines of animal industry, does not run itself but must be conducted on a scientific basis. As a rule poultry is maintained only in small flocks but recently an increased number of large poultry farms have been established, devoted exclusively to the raising of chickens, ducks, geese and turkeys. Thus, in the neighborhood of Petaluma, California, several square miles have been given up exclusively to this business and great success has attended these efforts. Again in the region of certain large poultry markets like New York many men have found handsome profits in buying chickens, ducks, geese and turkeys and putting them in a fine market condition at the right time to realize the best prices.

As a general thing, it may be asserted that success in the poultry business depends on the

knowledge of the business, construction of suitable houses, use of proper breeds, avoiding overcrowding, proper feeding and care of hens, recognition of the profitable laying age of fowls, and thorough care of chickens from the time of hatching.

In order to discuss some of the practical matters which must be considered in profitable poultry raising this chapter is divided into sections according to the kind of fowls concerned.

Chickens.—It is perhaps well to start out with the subject of feeding chickens. Too many people seem to act upon the theory that success with chickens can be had without giving any attention to their feeding. It is of course a fact that chickens will eat almost any kind of green material or grain food as well as waste materials and that under ordinary circumstances, especially where they have considerable freedom and opportunity to find insects and other food, no serious trouble arises. Certain phases of considerable importance in the feeding of chickens have been thoroughly demonstrated by experiments and better results can be obtained by giving proper heed to these experimental facts than by attempting to overlook them and to go into the chicken business headlong.

In the first place chickens need considerable variety in their ration which should always include animal food, ground grain, and some green feed.

Animal Feeds.—Chickens can perhaps utilize a larger amount of animal food in proportion to their weight than the larger farm animals and this is also true of ducks, geese and turkeys. No animal food need be excluded from the ration. They seem to relish and make good use of all of them. Thus, satisfactory results have been obtained from the use of milk albumen, beef scraps,

animal meal, bone meal, chopped meat, skim milk, offal from slaughtered animals, and various other animal materials either in a raw or cooked form. Preferably, however, these materials, if not from an infected animal, should be fed raw since they appear to act most beneficially on the digestion of the chicken in that condition. Sometimes it appears that in feeding for eggs the poultryman may be able to accomplish better results by the use of cheap fats like beef scraps than are obtained by feeding higher priced animal meals. As a rule, where direct comparison has been made between rations with and without animal meal or some other animal food it has been found that the greatest increase in weight has taken place in those animals which received meat meal. The difference in this respect is usually of considerable importance. A high grade of beef scraps may be obtained from packing houses and fresh meat and bone may be easily secured from local butchers and ground up as occasion requires. This constitutes an exceedingly cheap source of food for chickens and no opportunity should be lost to buy them whenever they can be obtained at reasonable prices. The use of animal meals in egg production is highly desirable from two considerations. In the first place, these foods contain large amounts of protein which is utilized in the formation of eggs, and in the second place, they do not tend to an overfat condition which is sure to result in relative sterility of the hens. As already hinted, however, it frequently happens that better results are obtained from beef scraps than with ground meat, ground bone, or milk albumen, and this material should always be utilized wherever it can be conveniently obtained. The great egg-producing value of

ground fresh meat has frequently been shown by comparing this food with meat meal which is an excellent egg producer. As a rule, ground fresh meat or fresh bone gives a larger increase in weight and leads to the production of more eggs than does meat meal. Fresh green bones, in addition to the protein which they contain, and which is a necessary element of the ration in egg production, contain also considerable quantities of lime compounds in the most available form in which they can be fed to the chickens. Ground fresh bones are far better sources of mineral material than are oyster shells or other cheap forms of calcareous material. It is commonly estimated that one pound of fresh bones is sufficient for sixteen hens. Bones should be run through a cutter before feeding.

Skim Milk.—Skim milk is an excellent and most effective feed for chickens of all ages. It may be given as a drink or may be mixed with ground grain or meal or compounded with beef scraps or animal meal. When added to a meal mixture, two pounds of milk are sufficient for one pound of meal. Skim milk is perhaps the best feed for producing a white skin in chickens, while animal meal, especially if fed in large quantities, gives a yellowish flesh sometimes of a decided color, an undesirable quality. The most economic gains are made in chickens when skim milk is fed both as a drink and added to the grain mixture. In addition to the animal feeds already mentioned, blood meal and tankage, if obtainable at reasonable prices, may be satisfactory and economic foods in fattening chickens and in increasing the egg production.

Grains.—There is scarcely any grain which may

not be fed to chickens with good results, with the possible exception of cotton seed meal, which may be left out of the list of chicken foods for the reason that it appears to exercise a somewhat poisonous effect. Thus, barley, buckwheat, corn, wheat, oats, rye, Kafir corn, millet, sunflower seeds, screenings, rice milling products, all kinds of ground and cracked grains and various weed seeds have been used in feeding chickens and all these materials have a place in the chicken ration. Throughout the corn belt corn is, of course, looked upon as the sovereign food for chickens as well as for the large farm animals and many fowls receive no other grain except corn. This furnishes a comparatively satisfactory ration where the fowls have a run so that they can pick up insects or other animal feed in addition to screenings and cracked grain. The chicken, by reason of its strong muscular gizzard, is capable of digesting minute seeds, cracked grain and other hard grain material much more thoroughly than the domestic mammals. For this reason much material which is unsuited as food for other farm animals may be kept for chickens and fed to them with excellent results. Corn is readily digested by chickens, whether fed whole or cracked or in the form of corn meal and whether fed moist or dry. If finely ground grain is fed, it is usually best to moisten the meal before feeding.

Buckwheat.—Throughout the region where it is produced this is considered a fine food for poultry. Where buckwheat has been compared directly with corn, the results have usually been somewhat in favor of corn. Either whole buckwheat or buckwheat middlings and bran are well worth feeding to chickens and produce results which are nearly always satisfactory.

In many localities peanuts are fed to chickens and the returns from this food are usually quite fine. Peanuts, as is well-known, contain a high percentage of both protein and fat and may, therefore, be used in feeding chickens for market, but are ordinarily not used for laying hens. Various rice products as well as wild rice have been tried for chicken feed. In one instance a direct comparison of rice and wheat gave results decidedly in favor of the rice as a food for the production of eggs. Rice milling products may be relatively too high in price, except in Louisiana and Texas, where these materials are produced in abundance.

Wheat.—This grain is everywhere fed to chickens and is considered excellent feed for them. Not only good whole wheat may be fed, but also cracked wheat, shrunken wheat, screenings, and frosted wheat with the reasonable hope of getting good returns from them. Where considerable animal food is given to chickens wheat appears to be not much superior to corn. The great value of wheat, however, appears in cases where little other protein is given in the ration. In some cases, where large quantities of skim milk have been fed to chickens, corn has proved quite superior to wheat. Corn has usually been found superior to wheat in rations where considerable animal food was used, while with beef scraps wheat and corn are about equal. Similar results have been obtained in rations containing milk albumen and other animal foods.

While barley, wheat, buckwheat and rice contain a relatively high percentage of protein it is, nevertheless, true that poultry sometimes require a more nitrogenous ration and one containing more animal material than is supplied by the ordinary

grains. In order, therefore, to avoid feeding a defective ration, it is often necessary to feed highly concentrated by-products such as the animal foods which have already been mentioned. For this purpose the use of milk albumen has usually given fine results. Gluten meal and gluten feeds are inferior to bone meals, especially in rations for young chickens. The inferiority of these nitrogenous materials is due to the relatively low amount of mineral material in them.

Proprietary Foods.—While balanced and economic rations have been determined by careful experiments for steers, sheep, dairy cows, hogs and horses, less attention has been given to this matter in the case of poultry until within recent years. As a result of the uncertainty which prevails regarding the proper rations for egg production and for fattening chickens, the venders of proprietary chicken foods have reaped a rich harvest in selling their comparatively cheap products for an exceedingly high price. It is often asked why there are so many more proprietary chicken foods than proprietary foods for cows, pigs, horses and sheep. The answer is obviously to be sought in the facts above mentioned. It is likely that when poultrymen have determined a suitable ration for chickens the same as for other animals the sale of proprietary or condimental chicken feeds will be very small. By this statement it is not meant to imply that no value attaches to proprietary chicken feeds on the market, but simply to indicate that the price demanded for these feeds is entirely too high as compared with their actual feeding value. Thus, from analyses of these feeds it appears that some have contained as high as eighty-nine per cent. of ash, which is principally carbonate of lime

or shell material. Since this substance could be obtained very cheaply by using oyster shells or other similar material it seems unbelieveable that poultrymen should continue to pay from twenty cents to forty cents a pound for material which is really worth about one-half cent a pound.

Green Feeds for Chickens.—If chickens are raised under conditions where they cannot have access to grass or other green material some green feed must be supplied to them in their pens or yards. For this purpose almost any garden stuff, grass or weeds are available and valuable, but the leguminous hays are most nutritious and effective both in the production of eggs and in putting meat on chickens. So well known is the value of alfalfa and clover that a number of chicken feeds are now on the market containing green alfalfa as a basis with grain and other materials added. This again is objectionable on account of the unnecessarily high price which must be paid for the material. It is far cheaper for the poultryman to buy his own alfalfa or clover if he does not raise it himself and grind it to feed hens. About one-third of the mash fed to poultry may be made of alfalfa and clover and when this material is fed the results are always satisfactory both in egg production and in gain in weight. Where chickens are allowed to run practically at pleasure they pick up as much green material as they require and are always observed to be fond of leguminous crops such as alfalfa, clover and peas. That the recommendation in favor of the constant green feed in the ration for chickens is based on practical feeding is proved by the fact that in all comparative feeding tests, where an excellent ration has been fed with and without green feed, the best results have always been ob-

tained from fowls to which the green material is given. The presence of green feed in the ration is most desirable and most effective in winter. Its influence is then apparent in the production of eggs. Since in summer fowls may obtain their own green feed, if not strictly confined, it is necessary to feed green feed only in winter and this may be done in the form of cheap cabbage, roots and other garden stuff or as above mentioned by alfalfa and clover hay which may be ground and moistened before feeding.

Mineral Matter in the Feed.—The actual lime and salts which are required by growing chickens in the formation of bones and by laying hens for the production of egg shells may be best supplied from ground bone. It must always be remembered that the importance of animal feeds in poultry feeding is much greater than in the case of other farm animals. In the case of ground bone the value of this material sometimes depends much more on the amount of mineral matter which it contains than on the protein. In New York tests were made to determine the importance of sand in feeding chickens, both in rations containing animal feed and in those which did not contain animal feed. In all cases it was found that chickens were in better health and made more efficient use of their feed when grit in some form was added to the ration. Grit may be supplied in the form of ground Florida rock phosphate or oyster shells, but in general oyster shells are the most undesirable manner in which mineral matter may be added to the ration. The great objection to oyster shells is that they seem to cause injury to the alimentary tract of the fowls and this does not happen from feeding ground rock, ground bone or sand. Even

the addition of sand was found to be of considerable importance. Finely ground bone supplies both lime and phosphorous, while oyster shells supply little but lime and when fed to chickens in large quantities nearly always produce an injurious effect and sometimes disease and death. The curious fact has been shown by experiments that there is advantage in mixing fine sand in the feed of chickens even when they are running on a floor covered with sand. Obviously the poultryman should secure their own mineral feeds rather than buy proprietary feeds containing them.

Narrow vs. Wide Rations.—With chickens as with other animals we must meet this question. It is comparatively easy to answer this question, however, since the best results have generally been obtained from the use of narrow rations in feeding for eggs and from slightly wider rations in fattening for market. As is well known an overfat condition in chickens is not conducive to egg production and this can best be avoided by feeding a comparatively narrow ration containing nitrogenous grains, animal feeds, green feeds rather than too much starch or fat. The narrow ration is likewise best for young chickens until they reach considerable size. During the forcing period for market it is not necessary to pay so much attention to the health of the chicken and a wider and cheaper ration may therefore be fed containing for example largely corn or corn meal. There is likewise economy in feeding wide rations since protein is more expensive than starch and sugar in feeding animals.

Heavy vs. Light Rations.—The position which the poultryman should take on this will also depend on the purpose for which he is feeding. During the later stages of feeding for market, fowls may be

induced to eat all that they will since gains are then most rapid and the cost of fattening is obviously diminished by shortening the period of fattening. In feeding for eggs, however, hens should be given rations which keep them of about a constant weight without producing an overfat condition. The effect of light and heavy feeding on the fertility of the eggs is apparent from the fact that when conditions are favorable for a high egg production the eggs hatch better than when the conditions are unfavorable. In some breeds of chickens which are slow in their actions and which rapidly fatten as the result of heavy feeding the eggs do not hatch well or if they do hatch do not produce vigorous chicks.

Ground vs. Whole Grain.—The fact that chickens possess a thick muscular gizzard may make it appear quite unnecessary to grind or otherwise prepare grain for feeding to them. Nevertheless this matter has been thoroughly tested by poultrymen. Where the grain ration consists of a mixture of corn and oats it has been found that with both young and old fowls better results are obtained when one-third of the grain ration is fed ground and moistened than when all of the grain is fed whole. On farms where poultry are allowed almost perfect freedom they thrive excellently well and produce a reasonable number of eggs without grinding or otherwise treating the grain ration. The grinding of grain relieves the gizzard to some extent and appears to make the grain more digestible. For light breeds of fowls kept for egg production it appears to be a good general practice to feed about one-third of the grain ground and the other two-thirds whole, scattering it in the litter. The use of too much ground feed or mash conduces

to laziness on the part of the fowls since it is fed in troughs or basins and the fowls do not have to search for it. By throwing the whole grain in the litter the material becomes somewhat hidden and the fowls are forced to take some exercise in scratching and finding the grain. On this account the use of some whole grain is generally recommended and this recommendation is based on better results obtained where the chickens are thus forced to take exercise than where they are allowed to eat large quantities of mash in a lazy manner.

Dry Feeding vs. Mash.—It is desirable to know the relative value of feeding grain cracked or ground in a dry form and after moistening. Where these two kinds of material have been compared it has been found that chickens are very fond of broken and whole grain moistened and that they will eat such material better than a dry mixture of finely ground grain. They will eat dry meal, however, in small quantities whenever they need it and always fill the crop before going to roost. Dry meal, however, is not eaten in such quantities as to cause the chickens to sit down and waste the day without taking exercise, thus becoming overfat. The latter objection, as already hinted, attaches to the excessive use of wet mash. It should not be understood that a general objection is made to the use of wet mash, since a small quantity in the morning, especially if fed warm, is an excellent stimulant in egg production. One system of feeding consists in the use of a warm morning meal of mash followed later in the day by green feed and whole grain thrown in the litter which will keep chickens busy searching during a large part of the day. Moreover at moulting and after the old feathers have become loose and the new feathers

are taking their place the use of mash is very effective in hastening the production of new feathers. In fattening, the use of mash feeds are far superior to dry feeds and this practice is followed by all poultrymen.

The Cost of Feeding Broilers.—A great amount of attention has been given to the production of broilers. The profit from feeding young animals is always greater than from feeding old birds, and this fact, in addition to the handsome prices which are realized on young broilers properly fed, has led a large number of people to engage in this special line of poultry raising. The total cost of feeding chickens up to the proper size and age for broilers varies in different parts of the country, depending on the cost of feed and the kinds of feed used. In South Carolina it has been found that the cost of feeding chickens up to eight weeks is about seven and one-half cents per head and to twelve weeks, twelve cents, or an average of one cent per week. These figures do not take account of the green feed used in forcing broilers for market but on all farms, especially where arrangements are made so that chickens have a suitable range, the cost of green feed is so small that it can be neglected in stating this side of the proposition.

Feeding Chickens for Market.—Owing to the fact that chickens can be marketed at an early age it is found unnecessary from a physiological standpoint to give strict attention to the balancing of the ration as in the case of animals which are kept to a greater age and are fed over a longer feeding period. The chief purpose of balancing the ration for chickens intended for market and not for breeding purposes is found in the fact that they put on gains faster and the process is therefore

more economic. In preparing chickens for market it is usually best to separate the cockerels and pullets into two flocks. They may then be fed on a porridge twice a day, prepared of four parts corn meal, two parts middlings, and one part beef scraps. The mixed material should be moistened with water or still better with milk. From experiments in Maine it is recommended that the amount of water or milk used should be enough to make a rather thin porridge. If fed on a fattening ration for four weeks they become meaty and soft and some feeders have found that they are in a better market condition than when fed on dry grains and given more liberty. It is not profitable for poultry raisers to sell chickens in a poor or medium condition. They have an active digestion and make good returns for the feed which they consume. It pays therefore in all cases to put enough feed in them to finish them up in a fat condition. One month is about the limit of a profitable fattening period and if proper attention is given to the chickens during this time they can be put in excellent market shape. In general it has been found that they will do as well on a fattening ration when kept in pens large enough to accomodate a hundred as when placed in small latticed coops containing only four chickens and kept with a small amount of exercise.

The Amount of Feed for Each Hen During the Year.—It is necessary to know how much a hen requires during the year in order to be in a position to estimate the proper amount of feed to buy or set aside for the use of a flock of fowls. Among Maine poultrymen it has been found that each hen will consume annually from fifty to fifty-five pounds of dry grain in additon to clover, roots and other

material added to the mash. A similar quantity of grain should be fed at the same time in the litter. Most poultrymen have found that the quantity of grain to be given may be well determined from a practical standpoint by allowing as much for each feed as a flock will eat during the course of an hour. In a long series of tests in which hens were found to require from fifty to fifty-five pounds of mash annually, each hen also received eighteen pounds of wheat, six and one-half pounds cracked corn, six pounds oats, six pounds oyster shells, three pounds dry bone and forty pounds of roots. On this ration good hens should average about fifty pounds of eggs per year. The annual cost per hen when such rations are used will vary from $1.50 to $1.75 per hen. In Utah it was found that, even with comparatively expensive grain rations, the annual cost of grain per hen varied from sixty-nine cents to $1.26. The value of eggs produced on native grains and legumes in Utah ranged in value from $1.29 to $2.78 per fowl according to the breed. In another series of experiments carried on in Utah it was found that the average value of eggs amounted from $2.06 to $3.60 per fowl per year and that the total cost of feeding was such that the eggs were produced at an average cost per dozen of six and one-half cents.

Roots.—Roots have a larger place in the ration for fowls, perhaps, than in those for the domestic mammals. This is largely due to the fact that chickens are omnivorous in their habits and will eat not only all of the standard grains and other feeds which are used in fattening large farm animals but also make good use of various feeds and by-products which would otherwise be waste material on the farm. As a result of very extensive experi-

ence in poultry feeding in California a number of rations have been found to give excellent results and one or two of them may well be mentioned in this connection. For a flock of one hundred hens it is well to allow for each day's food four pounds of corn meal, five pounds of wheat, five pounds barley, two pounds bran, two pounds alfalfa, one pound meat meal, one and one-half pounds blood meal. Various other ground animal feeds may be substituted for those in the above ration in a proper proportion. Thus we may use middlings, cocoanut oil cake, linseed meal, skim milk, shorts, and various materials which will readily occur to the poultryman. In fattening chickens for market excellent results have been obtained from the use of a mixture of two pounds ground oats, one pound ground barley, and one pound corn meal to which beef suet is added boiled in milk. Fowls are fed all they will eat of this mixture twice daily. After chickens have been forced about two weeks they begin to lose their appetite and a crammer may then be used if desirable. The ordinary crammer consists merely of an apparatus by which grain mixture or mash containing also some animal and green feed is forced down the chickens under pressure. The mixture is of course previously moistened to such an extent that it is semi-fluid. An all grain ration for fattening chickens is somewhat cheaper, but is considerably less effective than a mixture of grain and beef scraps.

The cost of gain in chickens usually amounts to about three to four cents a pound. Since the farmer can obtain at least ten and sometimes as high as twenty cents a pound for well-fattened fowls the profit from transforming grain and other farm products into chicken meat should be appar-

ent without further argument. As already hinted the chicken ration may contain grains of all kinds, either whole or in the form of a mash, boiled potatoes or other roots can be fed and if possible alfalfa and clover cut fine and moistened and animal feeds. It would be quite impossible to indicate all of the suitable combinations of farm feeds which may be used in fattening chickens and this would be unnecessary even if it were possible for the fact that many references have been made to suitable combinations which balance the ration for other farm animals, makes it evident that little difficulty will be experienced by the intelligent farmer in complying with these requirements in the feeding of chickens. The main point to be considered in fattening chickens is to change the ration frequently. While the fattening period for chickens lasts only about a month the chickens are sure to lose appetite and get off feed even in this short period unless suitable attention is given to the ration, particularly to the variation of its component parts.

An all-cooked ration is usually quite unsuitable for fattening fowls. Cooked food spoils the digestion of chickens and for this reason they should always receive a part of their ration raw. This may best be accomplished in so far as the grain part of the ration is concerned by feeding mash in the morning or afternoon and whole or cracked grain between meals by throwing this material into the litter where the fowls are forced to scratch for it.

Capons may be made from any breed, but preferably from the large meat breeds, such as Light Brahmas, Plymouth Rocks, Wyandottes, etc. In most markets where capons are known and where, therefore, a steady demand exists for them they

bring from two to six cents per pound more than ordinary poultry. There is no extra expense from feeding or caring for capons aside from the initial expense of caponizing. At the same time as found from wide experience in South Carolina and elsewhere capons grow faster and reach a larger size within a given time than cockerels. In a period of eight months capons usually exceed cockerels by about two to four pounds and in twelve months from four to five pounds, especially where large breeds are used. The average rooster at eight months of age will perhaps weigh six pounds whereas a capon will weigh about eight pounds and the total price realized by farmers in South Carolina is about forty-two cents for cockerels and eighty-eight cents for capons. The profit from capons is therefore relatively much higher than that from roosters.

In caponizing fowls the operation is often incompletely performed on a considerable number of fowls. Such birds are known as slips and bring a price intermediate between that of ordinary poultry and the capons. The reason for this is that in slips, and still more decidedly in capons, the amount of breast meat is greater and of a better quality. Moreover the structure and flavor of the meat of capons is universally recognized as superior to that of average fowls. In South Carolina and other states a curious use has been found for capons in addition to their value as meat. It appears that capons will take care of young chickens as well as, and in most cases, better than a hen. The hackle feathers, wing and tail feathers in the capon are larger than in the hen and they are, therefore, capable of covering more chickens. In most instances they seem to take kindly to this work

since otherwise they have no associates. As is well known neither hens nor roosters will have anything to do with capons and they therefore lack company unless allowed to take care of young chickens. They may, therefore, be used, if convenient in the place of brooders. Not only the breeds already mentioned may be used for the production of capons but also the Cochins, Langshans, Leghorns and Dorkings.

The operation of caponizing, while comparatively simple in the hands of an expert, requires, nevertheless, considerable skill which can only be obtained by actual practice. As a rule there is a large percentage of slips among the first attempts of a breeder to produce capons. It is usually recommended in caponizing cockerels that the fowl be placed in such a position that the sunlight strikes fairly upon it so that operator can see his work. The fowl is then laid upon its left side and the wings and legs are fastened so that it cannot move during the operation. Curiously enough, however, the operation itself often appears to cause no inconvenience or suffering to the fowl. If the side of the bird where the operation is to be done is moistened with cold water the bleeding will be greatly checked. Any common antiseptic may be added to the water to prevent complications. An incision about one inch long is made between the first and second ribs, the cut is then spread and a scoop spoon introduced. Some care must be exercised not to cut too near the backbone. The right testicle is first exposed after which by pushing the intestines aside the left may be seen and may be twisted off after which the other is removed. There are many companies which sell caponizing tools at a small price and any reliable firm will

give satisfactory results. In order to prevent accidents which are likely to happen during the first few operations it is excellent practice to operate first on a number of dead cockerels which have been killed for home use.

Age as Related to the Number of Eggs.—The universal experience of poultry raisers is that pullets during their first season lay more than during the second and the number of eggs rapidly falls off if they are kept longer. Thus in Utah a careful record was kept in which it appeared that forty-one fowls laid during a given period nine hundred and ten eggs as pullets and during the same season the next year only four hundred and thirty-seven eggs. It is a striking fact that pullets not only lay more eggs than two-year-olds or aged hens but they lay a much larger proportion of them in winter when the demand for eggs is greatest and the prices correspondingly high.

On the basis of uniform experience that pullets yield more eggs than old hens it is often recommended that they be killed at the end of the first laying season. This is good practice in some respects but occasionally it is observed that the fertility of the eggs obtained during the second season is greater than in those from pullets and for this reason some of the best layers may well be kept a second season in order to obtain eggs for hatching purposes.

Age and Gain.—It has already been stated that young fowls gain faster than older ones and that the economy of feeding is much greater. In one comparative test extending over a period of twenty-one days fowls which were three hundred days old at the beginning of the test gained only one-half as much as chickens which were ninety-five days old

when the fattening period began. Since the older fowls ate fully as much and in some cases more than the young fowls the great superiority of young fowls from a financial standpoint is quite manifest.

The Egg Type of Hen.—We have mutton and wool types of sheep, draft and speed types of horses, lard and bacon types of hogs, and beef and dairy types of cattle. It is highly pertinent therefore to ask whether there is an egg type of hen. Practical poultrymen have answered this question in different ways. Many men have studied certain qualities or characters which from their experience they believe indicate laying qualities in hens and on the basis of these characters fowls are separated into layers and non-layers. The success which attends such classifications obviously depends on the skill of the man who does the work and upon the keenness of his observation in selecting the proper characters upon which to divide the flock into two groups. Recently a patented system has been devised for separating hens into layers and non-layers on the basis of certain characters which indicate good laying qualities or lack of the same. From the successful experience of a number of poultrymen who have tried this system the writer can vouch for the importance of the scheme when the separation of the flock is done by a skilled poultryman.

It certainly requires no argument to show that the profit to be derived from a flock of fowls kept for eggs can be greatly increased if any system can be put in operation by means of which non-layers can be separated. These hens are, of course, mere dead weights and bring down the average of the flock. As soon as the poultryman has a scheme by which he can pick out the non-laying hens at

once they may be fattened and the full market-price obtained for them. He is thus saved the expense of wasting food on non-laying hens in the attempt to produce eggs from them. Not all of the schemes which have been devised to separate layers from non-layers are successful. Thus, in Utah the matter was tested by keeping a careful record of the egg yields of a number of hens of apparently different types, submitting the photographs of these hens to various individuals who posed as being able to differentiate between layers and non-layers. In this test the characters which were relied upon by the different experts failed entirely. The grouping of the different hens, as made by the different experts was entirely different, so that their classification appeared to be little more than guess work.

Coops vs. Yard Fattening.—Much difference of opinion prevails regarding the merits of close confinement and freedom in fattening fowls. In the majority of tests which have been carried out to answer this question the birds with a liberal run have given better results than those in coops, and the economy of meat production has been greater. This matter has been thoroughly tested by poultry raisers at home and abroad. English and French poultrymen who make a specialty of fattening poultry for market use small coops holding only five or six fowls and claim decided advantages for this method. In Canada coop feeding has been used quite widely with more or less satisfactory results. This problem has been studied in Maine with the result that the gains produced from fowls in small coops were equal to those claimed by French experts in eleven coops containing four birds each, while in twenty-four

other coops of the same size the gains were considerably less than in houses and yards. The results were in harmony with the belief and practice of the average poultryman and farmer, who raises poultry as a side line, to the effect that small coops in fattening fowls are not necessary to secure the finest market condition. In fact, most fowls appear to make greater gains and at least show greater economy in feeding when given some liberty.

With regard to the amount of exercise which is necessary for fowls it is useless to argue the matter if all fowls are lumped together, for some fowls appear to require more exercise than others. In the case of birds which are naturally lazy it is often desirable to feed them in such a manner that they are forced to scratch in order to obtain the grain. In a comparative test which was carried out in Utah the Leghorn stood enforced idleness better than other breeds but the effect of too close confinement was disastrous to the egg laying of all breeds. The only safe conclusion in this matter is that no exercise is decidedly bad. It is not necessary, however, to go to the opposite extreme since the best results of all have been obtained where a moderate amount of freedom or exercise is obtained. We have obviously the same problem with chickens as with other farm animals and the results obtained from experiments are largely in harmony throughout the whole series. Hens which have a free range and proper feed usually give better results in egg laying and in the fertility of the eggs than those which are too closely confined.

Marketing Poultry.—While the average farmer and poultryman can generally figure out that he makes a profit from his hens, it should be stated

that with better methods of preparing fowls for market the profit made from them would be much greater. Skill and experience in this respect count for as much as in any other line of animal industry. It requires but little thought to realize that the consumer will naturally select fowls which present the best and most sanitary appearance on the market. Other things being equal he will pay higher for such fowls. The dealer understands this fact well and will therefore be willing to pay a little higher price to the farmer. Any reasonable amount of time and expense in improving the appearance of poultry intended for sale is profitably spent. In handling eggs the neatness and effectiveness of the package have a great deal to do with the price received. Eggs should be properly graded according to size and in some markets according to color. Thus in Boston eggs are commonly classified as extra, first and ordinary, the highest price being obtained for brown eggs.

Before killing fowls for market they should be kept without food long enough to make sure that the crop is entirely empty. This is contrary to the practice of many poultry raisers who apparently want to obtain meat prices for cheap foods in the crop. Such food, however, rapidly ferments and adds an uncanny appearance to the fowls. The best way to kill fowls is to make a deep cut through the blood vessels in the neck at the junction of the neck and skull. For this purpose the knife should be inserted through the mouth. A slightly, higher price is paid for dry picked fowls than for those which are scalded before picking, but the work of dry picking is, of course, somewhat more tedious than after scalding. If fowls are to be picked dry the work must be done immediately

after they are killed and before they become cold.

At present the general practice is to market dressed poultry undrawn and commission men and dealers claim that in this form it keeps better than when drawn. The controversy on this point has reached an acute stage and both sides are seeking arguments with which to fortify themselves. It must be admitted that the feces and other similar materials contained in the intestines quite rapidly ooze through the intestinal walls and penetrate into the meat, giving it a disagreeable flavor. We have become so accustomed to eat cold-storage poultry which has been stored undrawn that the disagreeable flavor thus produced has come to be considered as normal. A comparison of such fowls with fowls freshly dressed under clean conditions will instantly dispel this idea. The difference is very marked. Under careless conditions, however, it is clearly apparent that drawn fowls are subject to changes due to the use of unclean water and uncleanly hands in drawing and picking the fowls. It must be admitted, however, that if fowls were picked and cleaned under such conditions as prevail in the slaughter of large animals in packing houses the best possible results might be obtained and without injuring the keeping quality of the fowls. In fact it may be seriously doubted whether undrawn fowls will keep as long as drawn fowls.

The ordinary market classes of fowls are broilers, roasters, fryers and capons. The first broilers usually appear in January and weigh from one and one-half to two pounds per pair. Roasters weigh about eight pounds per pair. Fryers are intermediate between roasters and broilers, weighing about six pounds per pair, but need not be in excellent condition and, therefore, usually bring

lower prices. The market classes of fowls include also the common poultry sold at all seasons of the year. In killing fowls for market it should be remembered that the by-products are worth saving, particularly if the farmer is operating on a large scale. All fresh blood should be saved since this furnishes an excellent food for laying and young fowls. The feathers of chickens, ducks and geese are worth from four and one-half cents to sixty cents per pound depending on the quality. The loss in dressing poultry varies somewhat according to the breed. In comparative tests carried on in Connecticut the loss in dressing varied from twenty-four per cent. in Barred Plymouth Rocks to thirty per cent. in Rosecomb Brown Leghorns.

Warmth During the Night for Hens.—It has frequently occurred to poultrymen that hens might be more comfortable and perhaps lay more eggs if kept warm at night, especially during the cold snaps of winter. This matter, however, depends entirely on how the heat is furnished. If with the heat a close and stuffy atmosphere prevails it does not pay to furnish warmth. In a number of instances curtains have been tried as a method of keeping hens warm at night. Usually, however, this device has not given satisfactory results.

Trap Nests.—It is, of course, an important matter to know whether a given hen is laying or not and the ordinary method used for determining this point is to use some form of trap nest by means of which the hen is marked by a ring or some other way so that it may be known just how many eggs she lays. A great variety of trap nests have been invented and placed on the market and very sturdy claims are made concerning the usefulness of these nests. In a series of tests in Rhode Island

twenty different kinds of patented trap nests were used with the result that none of them proved to be as effective as claimed by manufacturers, suffering from the further disadvantage that they were altogether too expensive. The best advice that can be given the poultryman on this point is to consult with some other poultryman who has used trap nests after which a home-made contrivance can be constructed fully as effective as the patented ones and for very slight expense.

Egg Production and Warm Houses.—The subject of warmth in hen houses may be approached from several points of view and some of these have already been mentioned. Warmth may be obtained by constructing the houses as tight as possible and depending on the sunlight and the heat of the bodies of the fowls or it may be supplied by some form of stove or hot-water apparatus. In West Virginia a comparison was made between the egg production of hens kept in loosely constructed houses and those in tight houses, both being without artificial heat. The number of eggs obtained from the hens in the warm house was one thousand from a flock of one hundred hens in excess of those obtained from those in the loosely constructed house. At local prices that meant a saving of $22.00. As already indicated, however, the matter of warmth for fowls is a somewhat relative one and it should not be insisted that fowls require a high temperature or that they will lay more eggs than when kept at a low temperature. Fowls may become accustomed to one condition or the other and then require a continuance of the temperature to which they are accustomed if they are to produce the best results in eggs.

The Fertility of Eggs.—The most vital question

to be asked concerning eggs which are to be set is, will they hatch? A great difference in this respect is noted in eggs from different hens and obtained under different conditions. It becomes an important problem, therefore, to determine as closely as possible what conditions tend to lower the fertility of eggs and what conditions tend to increase the fertility. We will first refer to conditions which unfavorably influence the fertility of eggs. If eggs are kept for a long time before incubating, especially in tightly closed cases, the fertility is better preserved than if kept in the open air. This indicates that eggs should not be too much exposed when intended for incubation. A greater strength of germ and higher fertility is observed in eggs which are kept at a temperature of seventy degrees F. before incubation than in those which are kept at the lower temperature of fifty degrees F. After a shipment of eggs from a breeder to a customer it is of little consequence whether the eggs are set or incubated at once or whether they are allowed to rest for a few days. A slight difference is perhaps in favor of not resting the eggs. The question is frequently asked also how soon eggs become fertile after mating begins and has been determined by experiments as being not longer than forty hours. That is eggs laid two days after the cockerels are placed with the hens are likely to be fertile. Eggs continue to be fertile for at least two weeks after the cockerel has been removed. There is no difference in the fertility of eggs of different shapes. In a comparison of twenty-five normal eggs with long eggs and roundish eggs the fertility and strength of germs appeared to be almost identical. Close confinement of hens exercises a strong influence on the fertility of eggs.

In some comparative incubation tests made in studying this point it has been found that fully three times as many infertile eggs were laid by hens closely confined as by those which had an unrestricted range. Another serious cause of infertility in eggs is overfeeding. Hens which are excessively fat are likely to lay a high percentage of eggs with weak germs or absolutely infertile.

A distinction is usually made between fertility, strength and vitality of eggs. The egg which begins development after incubation is said to be fertile although it may not result in a completely formed chicken. For practical purposes, however, there is no difference in the results whether the egg is absolutely infertile or whether the chicken dies before the end of the twenty-one days. In practice it has been found that chickens in eggs with weak germs die between the tenth and twenty-first days of incubation. Another cause of infertility is found in allowing hens to lay for too long a period before taking eggs for hatching. In hens which have laid industriously through the whole winter season the spring eggs show a low percentage of fertility until the hens have been allowed the freedom of an outside run for a week or so.

The fertility of eggs varies from zero to one hundred per cent. In a long series of tests in Rhode Island eggs obtained from different sources and under different conditions proved to be fertile to the extent of thirty-five per cent., forty-one per cent., forty-four per cent., and eighty-three per cent. under different conditions. A fertility of eighty per cent. is considered quite satisfactory. Eggs which will hatch under a hen will also hatch in the incubator. This point has been determined by numerous comparative tests. The incubator,

if properly handled, does not injure the vitality of the eggs. The fertility of eggs is always increased by giving the hens considerable freedom, exercise, fresh air. A long series of observations made on the causes of infertility in eggs in Canada show that in spring the egg germs become strong within twelve to fifteen days after the hens are allowed to run outside. In one series of incubation tests in which eight thousand, six hundred and seventy-seven eggs were used, seven thousand, two hundred and five or eighty-three per cent. were fertile. This may be considered a satisfactory percentage of fertility.

Moulting.—The moulting period which occurs in late summer, beginning usually in July is a dull time in the poultry yard. The hens do not lay during this period and make the most unfavorable appearance to be seen at any time of the year. In some cases the process of moulting seems to drag on unnecessarily long and some attention has been given by poultrymen to hastening this matter and getting it finished as soon as possible. Perhaps the most successful means of accomplishing this is known as the Van Dreser method and has been tested in various parts of Canada and the United States. This consists simply in reducing the ration decidedly during the first part of July. The hens stop laying and the reduced amount of nutriment seems to further the shedding of the feathers. As soon as the feathers are fairly well shed, that is after a period of two or three weeks, a heavy ration is resumed. The theory upon which this is based is that the reduction of the ration causes a shedding of the feathers while the increased ration is required later to furnish material for the rapid growth of new feathers. The ordinary moulting

period is from ten to twelve weeks, but may be shortened to eight weeks by proper feeding as just suggested. If the moulting period is allowed to continue too long the fowls go into the winter in a shabby condition and it may not be possible to induce them to lay at all during the season when eggs are most in demand.

The Flavor of Eggs and the Color of the Yolk.—The question is sometimes asked whether the kind of feed given to hens has any influence upon the flavor of the eggs. In some tests this appears not to be the case. Even when oil of sassafras, celery oil and other flavoring materials were added to the ration, they had no bad effect on the eggs. It frequently happens, however, that the use of onions lends a slight taint to the eggs. In general where the poultryman desires to produce only the best quality of eggs and satisfy his customers in every respect it is of course desirable not to take chances with the use of foods which may taint the eggs. The color of the yolk may be easily affected by the ration. Thus the use of wheat and white corn or oats without any other grain feed has a tendency to produce yolks of too light color to satisfy the fancy taste. Yellow corn is useful, however, in giving a rich color to the yolk. In Utah it has been found that corn and wheat were not as influential in determining the color of the yolk as was alfalfa. In a series of tests it was found that eggs were too light colored whatever grain ration was fed if alfalfa was omitted from the feed. As soon as alfalfa was added to the ration again the color of the yolk improved.

Egg Preservation.—Eggs should be cared for as attentively as milk. As soon as gathered they should be put in a cool place free from dirt since

disagreeable odors are readily absorbed through the shells. The hens should have clean, wholesome feed and when the eggs are being produced for market it is best not to have the cockerel with the hens since the unfertilized eggs have the best flavor. In artificial preservation of eggs a great variety of substances have been employed including water glass, lime water, salt, vaseline, dry wood ashes, gypsum, sulphur, permanganate of potash, salicylic acid, salt brine, and other materials. By far the best results have been obtained on the whole from the use of lime water or water glass solutions. Lime water used at the rate of one pound to five gallons gives excellent results with comparatively fresh eggs. In Canada lime water has been found equal to water glass and much to be preferred on account of economy and ease of preparation. Water glass solution has been widely tested and recommended as superior to any home preparation. The results obtained from comparative tests, however, do not bear out the claims made for the water glass. The ordinary strength of water glass used in preserving eggs is three per cent. to ten per cent. in water. The ten per cent. solution is stronger than necessary and sometimes gives unfavorable results. The lime water solution may be mixed with salt and the combination is exceedingly effective.

Vaseline will preserve eggs for a few days or two or three weeks, but for longer periods it is very unsatisfactory since the eggs spoil as a result of the exclusion of the air and a disagreeable flavor penetrates into the egg. Likewise with wood ashes the yolk soon becomes gummy and of dark color. Gypsum if used in long periods of preservation will ruin nearly all the eggs. Sulphur also ruins the

eggs. The quality of the eggs after long preservation is about equal from the use of water glass and lime solution while in the case of other preservatives the quality is much injured. The loss from evaporation in eggs preserved in dry salt after several months is thirty-three per cent., from eggs waxed and then preserved in salt twenty-five per cent., and no evaporation takes place in eggs immersed in lime water or water glass solution.

The Cost of Egg Production.—Cornell University carried on an extensive series of experiments for the purpose of determining the cost of egg production in different flocks of poultry throughout the state. In the first series of tests it was found that the cost of producing eggs on ordinary farms ranged from eight to thirty-four cents per dozen while the cost of food for one hundred hens for seventeen weeks ranged from $28 to $39. The average profit for a period of seventeen weeks was found to be $23.93 for each one hundred hens. In a subsequent test the average annual production per hen was one hundred and twenty-nine eggs. The average cost of eggs per dozen was nine cents and the average cost of feeding one hen a year was ninety-nine cents. In this series of observations of actual farm conditions it appeared that forty-four per cent. of the total value of the eggs produced was required for the feed and that the annual value of eggs exceeded the cost of feed by $1.30 for each hen. These experiments were carried on during still another year in which it appeared that the average cost of feeding one hundred hens for seventeen weeks was $35.33, and the average profit from one hundred hens for this period was $16.13. In a comparison of different breeds the White Leghorn stood first and the Black Minorca

last in egg production while in economy of feeding a Black Minorca and White Wyandotte cross stood first and Black Minorca last.

Egg Production and Space for Hens.—It is obvious that hens require some room, especially in their houses, in order to produce the best results. The factor of overcrowding in egg production has been tested in Maine where it was found that the number of eggs diminished rapidly when the hens were crowded beyond a comfortable limit in houses.

Increasing the Number of Eggs by Breeding.—Many poultrymen have tested the effect of building up the flock of hens by selecting those which lay a large number of eggs and using these eggs for hatching out the birds of the future flocks. In this way flocks have been built up in which nearly every hen will lay from two hundred to two hundred and fifty eggs per year. There can be no question that the egg production of a flock of fowls can be appreciably increased by careful selection of the birds. This system of selection is based on the practical idea that the offspring of the best laying hens should lay more eggs than those from poorer hens. The same principle works out in practice in breeding other animals and would naturally be expected to hold good for fowls. Tests thus far made by poultrymen have shown this to be true. The same methods have been adopted in the East and West and it appears certain that the hen has the power of transmitting her laying qualities to offspring. On account of the fact that eggs of uniform size are desired for market appearance the same attempt has been made to determine whether uniformity in size was a matter which could be regulated by selection. It has been found

possible to produce a strain of fowls which will lay eggs of a fairly uniform size and of a uniform color.

Breeds.—Among the almost innumerable breeds of fowls which have been produced by poultrymen and fanciers it is impossible to mention more than a few of those which are of real value and productiveness under ordinary conditions. The chicken breeds for the farmer are probably the Barred and White Plymouth Rock, White Wyandotte, and Buff Orpington. This may seem to be an unnecessary discrimination against many breeds which are known to be excellent layers and fairly good meat makers. The birds mentioned are what might be called general purpose breeds, being good layers and capable of producing a large quantity of excellent meat. In a series of comparisons made in Canada regarding the cost of gain in different breeds the Light Brahma stood first at three and seven-tenths cents per pound followed by White Plymouth Rock, Faverolle, Dorking and Buff Orpington at three and eight-tenths cents per pound, Barred Plymouth Rock at four cents, White Wyandotte four and two-tenths cents, Indian Game four and five-tenths cents, and Rhode Island Red four and seven-tenths cents. In selecting birds for use on the farm it is desirable to know the color of the flesh. The Hamburg, Minorca, Andalusian, Red Cap and Black Orpington are black-fleshed breeds. The Leghorn, Ancona, Plymouth Rock, Wyandotte and Brahma are yellow-fleshed while the Houdan, Buff Orpington and Scotch Gray are white-fleshed breeds. In Utah a number of comparisons have been made between breeds to determine their relative merits. In one test the average annual profit per hen from Barred Plymouth Rocks was

fifty-one cents; for Wyandottes, eighty-eight cents, and for Leghorns, $1.12. In comparing the weight of eggs of different breeds it was found that Wyandotte pullets laid eggs weighing one and a half pounds per dozen and Leghorns one and thirty-seven hundredths pounds per dozen.

The breeds of fowls which we have to deal with in this country are classified according to their original geographic origin. Following this system the American breeds include the various kinds of Plymouth Rocks, Wyandottes, Javas, American Dominiques and Jersey Blues. The French class includes Houdans, Crevecoeurs, and La Fleche. The Asiatic class includes Brahmas, Cochins and Langshans, while other classes have been established to include the Polish, Hamburg, English and miscellaneous birds. The best practical classification divides fowls into general purpose breeds, which include the American breeds; meat fowls, which include the Asiatic breeds; and egg breeds, which include the Mediterranean class of Dominiques, Leghorns, Minorcas, Andalusian and Black Spanish. According to this system of classification all other breeds would be referred to as ornamental.

Incubation.—The chief advantage of incubation by artificial means is that the eggs may be hatched earlier in the season than hens can normally be induced to sit and the business can be conducted on a much larger scale than is practical with hens. It requires far less time to watch an incubator holding two hundred eggs than to care for enough hens to cover the same number of eggs. In fact in South Carolina it has been found that the cost of feed alone for the hens is greater than the cost of managing incubators for the same number of eggs. Incubators should be kept in a cellar or

room where the surrounding temperature does not vary greatly. The incubator should be started running a few days before the eggs are to be placed in it in order to determine whether the regulator is running evenly or not. It is generally recommended that eggs should be turned twice daily after they have been put in the incubator for about forty-eight hours. Within from five to seven days the eggs should be tested by taking out of the incubator and holding before a light. Fertile eggs at this time will show a dark spot surrounded by a net work of veins while unfertile eggs will appear clear. They should therefore be removed and may be used for cooking purposes or for feeding to young chickens. The temperature of the incubator should range from one hundred and two to one hundred and three F. and may be easily regulated by means of a thermostat which is provided with all makes of incubators. There is no point in making a decision here between the different makes of incubators. Nearly every one who has used them is prejudiced in favor of the one with which he is acquainted and the beginner will do best to look into the matter in a practical way by consulting with some one who has had experience with them. The amount of ventilation required in incubators is a matter about which some difference of opinion prevails. It has been found by actual experience that too much ventilation and too low a per cent. of carbonic acid in the air of the incubator tends to cause chickens to die before they are fully developed. The action of carbonic acid consists in softening or disolving the egg shells but does not affect the egg membrane inside the shell.

During incubation the eggs gradually decrease in weight. During the first five days they lose

LAYING HOUSES.

These are all built on the scratching shed plan with large runs. The thrifty plum trees show how well they are adapted to chicken yards.

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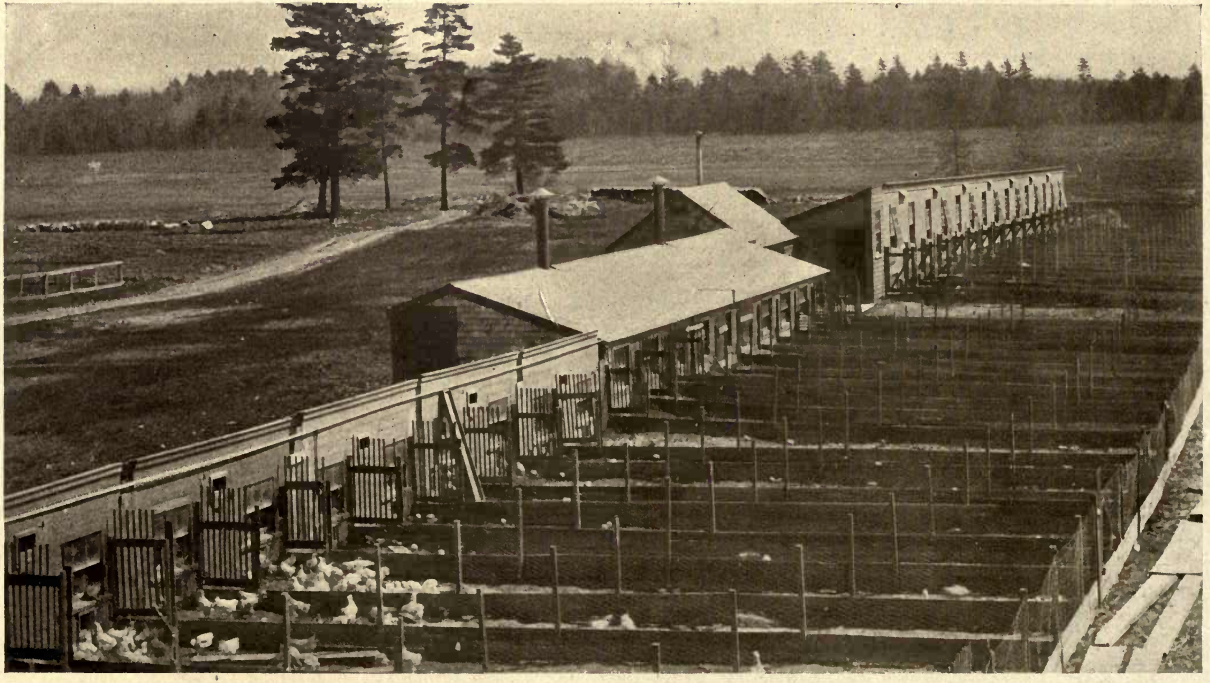


POULTRY HOUSES AND YARDS ARRANGED FOR SEPARATING DIFFERENT BREEDS, AND CHICKS OF DIFFERENT AGES.

about five per cent., during the second week about six per cent. of their weight and during the third week about seven per cent. This loss in weight is of course due to evaporation of moisture through the egg shell. Most manufacturers of incubators recommend that the eggs be moistened daily with tepid water. It may be advisable for the beginner to adopt this practice. Many poultrymen of long experience have found that this is not necessary when all the conditions are thoroughly understood.

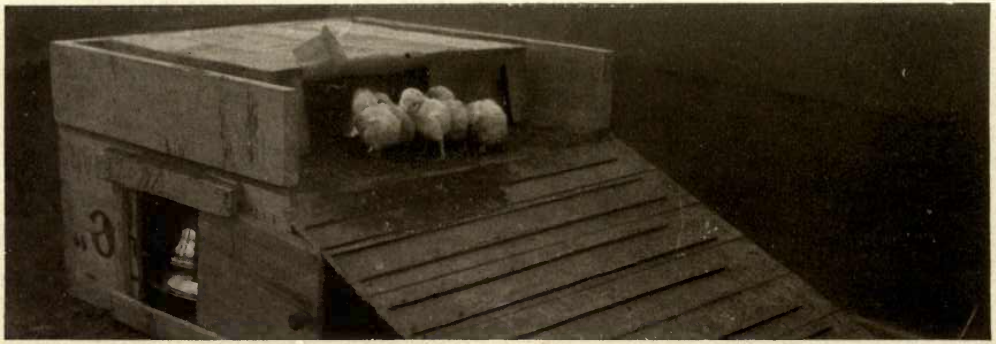
Brooders are a source of great loss and disappointment unless properly managed. These troubles, however, may be combated in a comparatively simple way. In the first place the brooder should be thoroughly cleaned between each brood of chickens which are kept in it. Otherwise it will sooner or later become infected and spread tuberculosis, diarrhea and death among the chickens which are placed in it. One of the most important matters in connection with the management of the brooder is to keep the temperature as uniform as possible and avoid the heating of one point around which the chicks will congregate and smother one another. If poultry is managed on a large scale the best results are obtained from the construction of large brooder houses in which the proper temperature for chickens can be secured with creeps surrounded with thick curtains in which a slightly higher temperature is maintained.

The Care of Young Chickens.—With chickens as with other animals if an early maturity is to be obtained it is necessary to start in the right way, and keep the animals growing uniformly and in good condition. As every one knows who has had even a short experience with chickens, if they are stunted during their early life it is impossible to get a

normal size or development from them. The feeding and care are therefore of prime importance in the production of poultry. Probably more financial loss is suffered from inattention at this time than from all other causes combined.

For the first few days different poultrymen have different rations which they use with excellent results. A bread may be made of three parts corn meal, one part bran and one part middlings or flour soaked with skim milk. After thoroughly baking and crumbling it may be fed to chickens during the first few days together with a small amount of hard boiled eggs, ground fine, shell and all. Bread and grain mixed may be used as the ration for the next two or three weeks after which beef scraps are added in a finely ground condition. This is not the only ration which has proved to be successful in raising chicks, but will probably give better results in a majority of cases than the much advertised proprietary chicken foods. A small amount of grit in the form of fine sand should always be added to the ration for young chicks. Particular attention must be given to keeping the food clean and sweet. It must never be allowed to remain more than two or three minutes after the chickens are through with their meal. Charcoal, ground bone and sliced roots may be placed so as to be always convenient for the chicks.

Diseases.—Unfortunately chickens as well as other domestic animals are subject to a number of diseases and these are often exceedingly trying and troublesome for the poultry raiser. If the business is carried on in a small way and the individual is so constituted that he can patiently fuss with each sick bird it may be possible to save a large percentage of them, no matter what the disease is. In



Courtesy of Storrs Agricultural Experiment Station.

A HOME-MADE BROODER — CHEAP AND EFFECTIVE.

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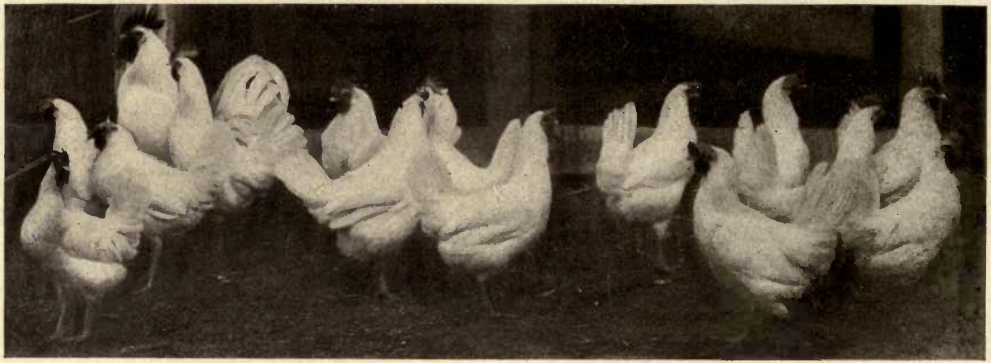


A BREEDING PEN OF THE "BIG KIND" OF WHITE LEGHORNS.

A fair average of a successful farm's laying stock.

Photograph furnished by James Rankin.

DUCKLINGS FIVE WEEKS OLD.

The Pekin is best for the production of "green ducks."

dealing with poultry on a large scale however it is necessary to exercise the greatest care to prevent the outbreak of poultry diseases, since when once an infectious disease is started it is an exceedingly tedious matter to try to save the sick birds.

One of the most dreaded of poultry diseases is fowl cholera. This makes itself known by its rapid spread and by the loss of flesh and emaciation of the fowls accompanied by diarrhea and other digestive disturbances as well as high fever and great stupidity of infected fowls. The disease may be readily suspected from its rapid spread among a flock of fowls. There is no practical use in attempting to treat fowl cholera. The only thing that can be done is to stop its spread. All affected birds should be killed at once and burned or buried and the premises must be thoroughly disinfected with a two per cent. solution of chloride of lime, whitewash, a one per cent. solution of carbolic acid, a strong solution of blue vitriol, or some other convenient antiseptic. Uninfected fowls may be protected to some extent by the removal of the affected fowls and by adding to their drinking water corrosive sublimate so as to make a solution of about one in two or three thousand.

Roup, or as it is sometimes known, chicken diphtheria, is a highly contagious disease which affects the membranes of the throat, nose and eyes and may extend farther down into the lungs and breathing passages. Roup may be recognized by the thick yellow material which commonly forms in the throat and nostrils and may also cover up the eyes and render the fowls entirely blind. This material sometimes accumulates in large quantities under the eyelid. If fowls are untreated they may

live on for several days, recovering in a small percentage of cases, or more often strangling to death as the false membrane which characterizes the disease forms and thickens in the larynx and windpipe. When roup is first noted it may be treated by removing all of the false membrane with a dull knife or a small stick and treating the affected surfaces with lunar caustic after which the mouth and nose may be washed with a solution of nitrate of silver at the rate of eight grains in an ounce of water. The success from any method of treating roup, however, is not very comforting to the poultry raisers. In California and at Cornell University a large series of remedies have been tried and many of them proved to be quite ineffective after they had apparently given good results in a number of cases. Many birds are relieved or cured by dipping their heads in kerosene, a weak solution of permanganate of potash may be used in the same way. Prevention is the important factor in controlling this disease, however. The essential element of prevention consists in the isolation of all diseased birds and the removal of the uninfected ones to clean quarters.

Occasionally quite serious outbreaks of tuberculosis occur among poultry. Strangely enough this disease has been recently found quite extensively in California. There is of course no satisfactory treatment for this and reliance must be placed upon sanitary, cleanly quarters and other methods of prevention. The disease known as leukemia sometimes affects fowls and causes them to stand in a crouched position for long periods. They show a high fever but usually no diarrhea. This appears largely to be confined to the small intestines and is highly contagious. In many cases the appetite

remains active until shortly before the fowl dies. This disease may also be controlled by the proper sanitation of poultry houses. Likewise with "going light," a disease in which diarrhea appears and the affected fowls drag on until all the muscle disappears. This trouble may sometimes be checked by giving laxatives like castor oil followed by tonic foods. Gapes in young chickens may be cured if the owner has time to bother with the trouble by applying turpentine to the inside of the throat with a feather. Occasionally forcing chickens to inhale irritating gases will make them cough so as to expel a portion of the gape worms which are attached to the inside of the windpipe. Since it appears that this worm gains entrance to the chicken from the bodies of angle worms upon which chickens feed it is desirable during the first few weeks to keep chickens on dry board floors and not allow them access to garden soil where they may get worms.

Chicken pox, or Sore Head may be treated by painting with iodine or washing with a weak solution of potassium permanganate. The places where chickens are kept sometimes becomes fearfully infested with lice and other insect pests. It is necessary to wage continual warfare against these vermin in the warmer climates. This may best be accomplished by isolating the roosts as far as possible from other structures in the hen houses, spraying them occasionally with kerosene and spraying the walls of the hen houses with kerosene emulsion at intervals of two or three weeks. This is quite effective and is comparatively inexpensive.

DUCKS

While many breeds of ducks have been produced and are reared in domestication in this and other countries there are not more than six breeds which may conscientiously be recommended to the farmer as profitable birds to raise. The best of these is the Pekin which is of a pure white color and is distinguished from the Aylesbury by its slightly larger size and turned-up tail feathers. The Pekin matures more rapidly than any other breed and is therefore the most profitable in the production of so-called green ducks which correspond in duck raising to baby beef in cattle raising. The Aylesbury is also white but slightly smaller than the Pekin with straight tail feathers. This duck is very popular in England and Europe. The Aylesbury sometimes reaches a weight of eighteen pounds per pair. The Rouen are brilliantly colored ducks, marked very similarly to the wild mallard and evidently being related to this species. The Rouen is of good disposition, rather hardy and matures quite rapidly. The drake often reaches a weight of nine pounds and the duck eight pounds. Their meat is of fine color and flavor. The Black Cayuga as its name indicates, is black in color and originated in the central part of New York state. They are not as extensively raised as the breeds above mentioned but those who have had experience with them are well satisfied with their qualities. The color is somewhat against them for market purposes but the meat is excellent. In addition to these four breeds the colored and white Muscovy ducks are raised to some extent on farms. They come from South America and are of very different form from those which have been mentioned. They are

quite strong fliers and in a wild condition nest in trees. They are unsatisfactory for farm ducks on account of their nervous disposition and quarrelsome habits. It is not possible in this connection to enter into a description of the form and qualities of the colored and white Call ducks, Black East Indian ducks, Crested White ducks, which are merely ornamental and not capable of yielding profits to the farmer.

The Management of Ducks.—The duck industry has developed rapidly during the past twenty years. Previous to that time there was not much demand for ducks as food and this was due partly to the fact that little attention was given to feeding them and they were allowed to eat fish and other aquatic animals so that their flesh was badly flavored and quite unsuited for human food. Recently, however, the number of special duck farms has increased considerably so that there are now farms which raise ten thousand to twenty thousand ducks per year and use as much as three tons of food daily in fattening the birds. Ducks are well adapted to raising on a large scale and it should be stated at the outset that it is not necessary to have ponds or other water supply for them to swim in. It has been demonstrated beyond question that ducks do equally well or perhaps better when they are not allowed access to water except for drinking purposes. Duck eggs may be hatched under hens or in incubators, for as a rule the modern duck is not a good sitter and has the very irregular habit of laying her eggs on the ground or wherever the idea occurs to her. It is therefore necessary to gather them and put them under hens or in incubators. The period of incubation is about twenty-eight days and the eggs require about the same treatment

as hens' eggs excepting that it may be more essential to moisten the eggs with tepid water two or three days before hatching. Young ducks may be kept in brooders in which a similar temperature and similar care is provided as for young chicks. Ducks, however, are somewhat more hardy than young chickens and less subject to diarrhea.

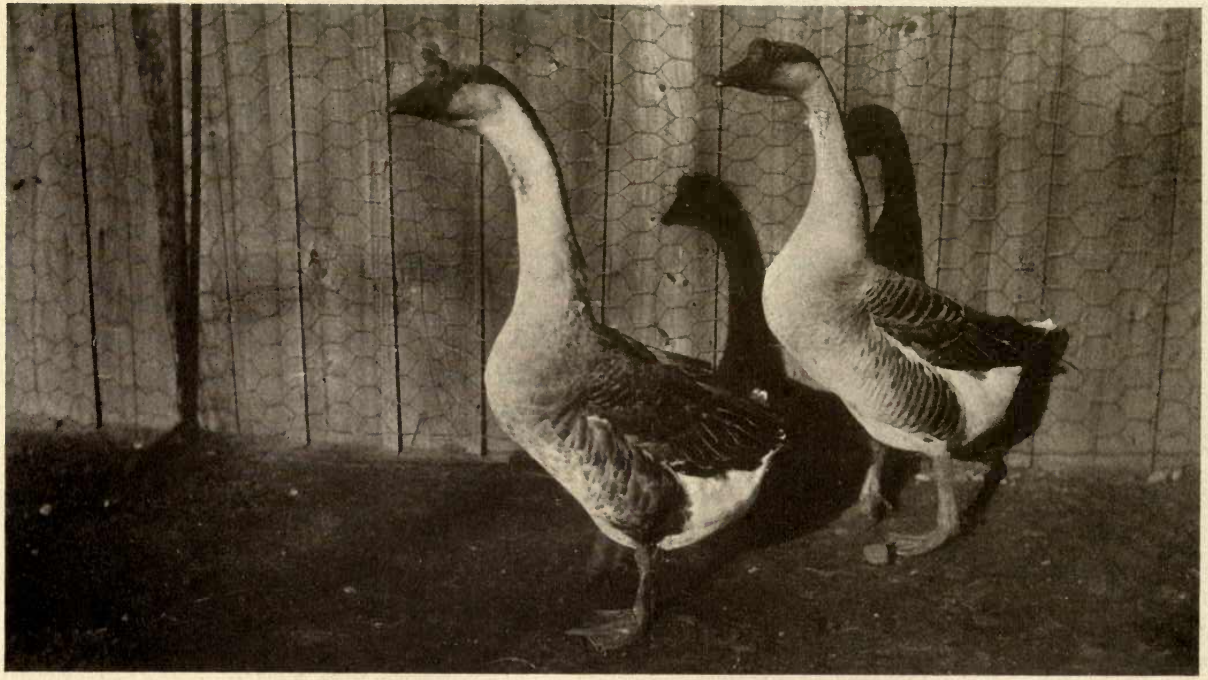
Feeding Ducks.—Ducks have no crop and therefore should not receive whole grains such as are recommended for young chickens. Their diet should consist of soft vegetable and animal food. The grain feed should be finely ground and fed in the form of a mash together with finely cut vegetables, grass and animal feed. A system of feeding highly recommended by some duck raisers consists in the use of a mixture of bread crumbs, green material, boiled eggs, and five per cent. of sand mixed with water and fed four times per day for the first five days. During the next fifteen days a mixture of wheat, bran, corn, and rolled oats, beef scraps, sand and clover may be used. For the succeeding twenty-two days, bran, corn meal, beef scraps, sand and clover are recommended, and finally during the last few weeks a similar mixture in which the corn meal is considerably increased. The amount to be fed naturally varies according to the size of the ducks. The feed should be measured out in rations such as they will eat up clean or if any is left it should at once be removed in order to keep the pens in a sanitary condition. Oyster shells or some other form of grit should always be present for young ducks. Breeding stock should be fed on rations similar to those already mentioned, that is, containing a considerable quantity of grain, beef scraps and other animal feed and using a relatively small amount of green feed.

In a test of the value of animal feeds in New York it was found that the rations which contained animal food were far superior to those of exclusive vegetable origin but having the same amount of nutriment. It has been found possible to supply from ninety-four to ninety-eight per cent. of the total amount of nitrogenous material in the ration in the form of animal food without any bad effect on the ducks. As a rule about sixty per cent. of the nitrogenous food in the ration may be supplied in the form of animal feed. After this large percentage of animal food has been fed for the first five or six weeks it is more economical to continue on the cheaper grain foods the remainder of the fattening period. According to some comparative tests dried blood and bone meal appear to produce a more rapid rate of gain in ducklings than animal meal and milk albumen. One of the finest animal feeds for ducks is skim milk. In feeding any kind of poultry skim milk, however, it should be placed in troughs or vessels in such a way that young birds cannot soil themselves with it as otherwise the feathers become sticky and the birds are uncomfortable. Ducklings forced to an early maturity at about the age of ten weeks are profitable fowls to raise in any locality where a market for these birds has been developed. In Utah it was found that such ducklings produced a profit of sixty-five cents per head from the food consumed.

Ducks are subject to some of the same diseases which affect chickens and if such troubles break out they may be treated in the same manner. As a rule, however, ducks appear to be more hardy than chickens and do not suffer from such diseases as scaly legs, sore head, tuberculosis, leukemia or

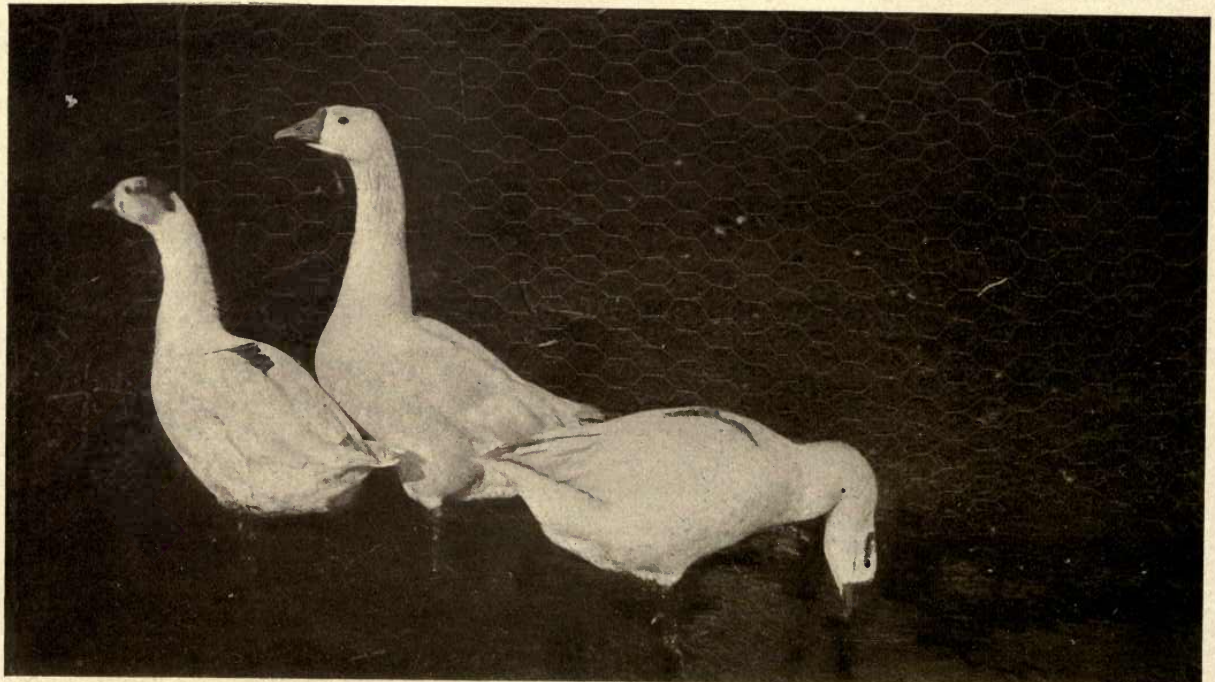
"going light." Occasionally diarrhea breaks out among ducks and runs a very rapid course with a high death rate. The only thing to do in such a case is to separate the heatlhy from the diseased birds immediately and to disinfect the premises thoroughly.

It should be stated for the benefit of those who have not raised ducks in the way of comparing the troubles and profits of the business with chickens that ducks are easily hatched and reared by artificial means, that the Pekin breed is best and should average a weight of five pounds at ten weeks of age. Ducks grow faster and cost less than chickens. While chickens will weigh one and one-half to two pounds at ten weeks ducks will weigh five pounds or even more. The cost of raising ducks to the age of ten weeks should not be more than forty-five cents and the market price is usually ninety cents. In some parts of England the best results have been obtained in fattening ducks, by feeding a mixture of boiled rice and meat or chopped cracklings. Various other fattening rations for ducks have been suggested but the one given above will prove perfectly satisfactory and various changes and substitutions may be made at the discretion of the individual duck raiser. The domestic duck is quite polygamous, although not so strongly so as the common fowl. Early in the season about three to five ducks should be allowed to each drake and still later the number may be increased from ten to twelve. Vigorous ducks should lay from one hundred to one hundred and forty eggs per season and the fertility of these eggs is comparatively high.



Courtesy of Rhode Island Experiment Station.

BROWN CHINA GEESE—GOOD LAYERS AND WITH ERECT CARRIAGE.



Courtesy of Rhode Island Experiment Station.

CROSS-BRED WHITE CHINA-EMDEN GEESE.

The cross is often more hardy than the parent breed.

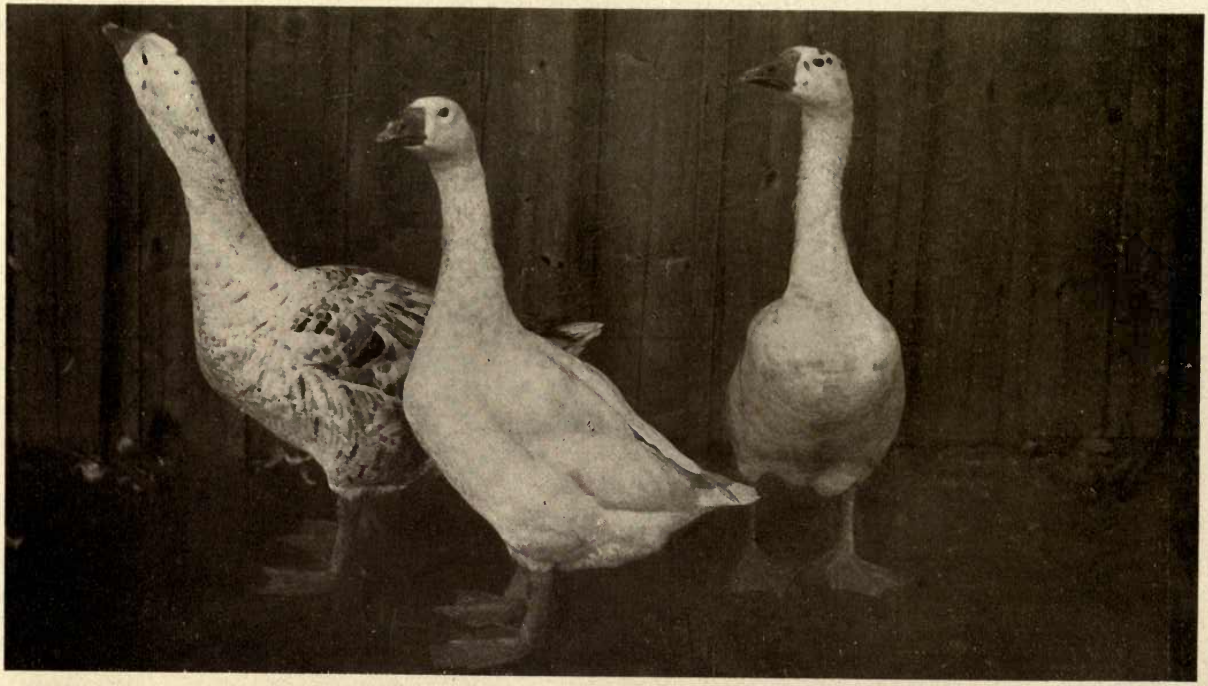
GEESE

The profitable breeds of geese in this country are six in number while some other fancy breeds, like the Colored Egyptian geese, have been introduced and are raised to a small extent for ornamental purposes. The Toulouse geese come from France, are gray in color and are quite generally popular as farm birds. They lay about forty eggs per season. The meat, however, is a trifle coarse. The average weight for an adult bird is about twenty pounds. Embden geese come from Westphalia, are pure white in color, somewhat more erect in carriage than the Toulouse and are somewhat smaller. The African geese are gray in color with a knob at the base of the bill on the top of the head. The knob is black and the prominent dewlap under the throat is gray. The African geese are the most profitable of all breeds of geese to raise for meat. They mature most rapidly and are ready for market at the age of ten weeks when they weigh from eight to ten pounds. The Colored and White China geese are lighter than the breeds already mentioned, weighing about seven pounds less per bird. They lay more eggs than the other breeds, however, averaging fifty or sixty per year. Both of these breeds have a knob on the top of the head at the base of the bill but are distinguished from other geese in their erect carriage. Wild geese are widely domesticated and raised in nearly every state in the country. These birds are sometimes considered rather difficult to raise, but fine success has been had by most individuals who have attended to the business. They have a long slender neck with a small head and a white stripe behind the eyes. The adult birds weigh from fourteen to

sixteen pounds. The wild goose is much used in breeding mongrels which are sterile crosses between this wild form and the domestic breeds of geese. The mongrel is greatly prized for its excellent quality of meat. The business of producing these mongrels is a specialty which requires considerable skill and experience.

Geese cannot be raised on a large scale like chickens and ducks. This is partly due to their requirement of a large run and to the fact that they are not so polygamous as other farm poultry. The gander may be induced to mate with three or four but seldom more geese. This makes it necessary to maintain a large number of ganders if the flock is to be of unusual size and necessarily entails additional expense. It is a very uncommon sight, therefore, to see any large number of geese on the ordinary farm. A number of geese feeders have developed a considerable business in buying up geese raised on the farm and fattening them for a period of two or three weeks before putting them on the market. In this way special geese feeding farms where several thousand geese are fed for market each year are established.

Geese live to a very great age. Instances have been known of their reaching one hundred years and they frequently remain vigorous and lay a tolerably large number of fertile eggs up to twenty-five or thirty years of age. The ganders, however, are somewhat unreliable after from seven to nine years, but the wild Canada geese may be profitably kept for twenty-five years or longer. With geese it is desirable to have water for bathing purposes and waste land around ponds or unused springs may be profitably utilized as a goose pasture. Two or three layings of eggs per season may be obtained



Courtesy of Rhode Island Experiment Station.

CROSS-BRED EMDEN-BROWN CHINA GEESE—GOOD, HEAVY FARM BIRDS.

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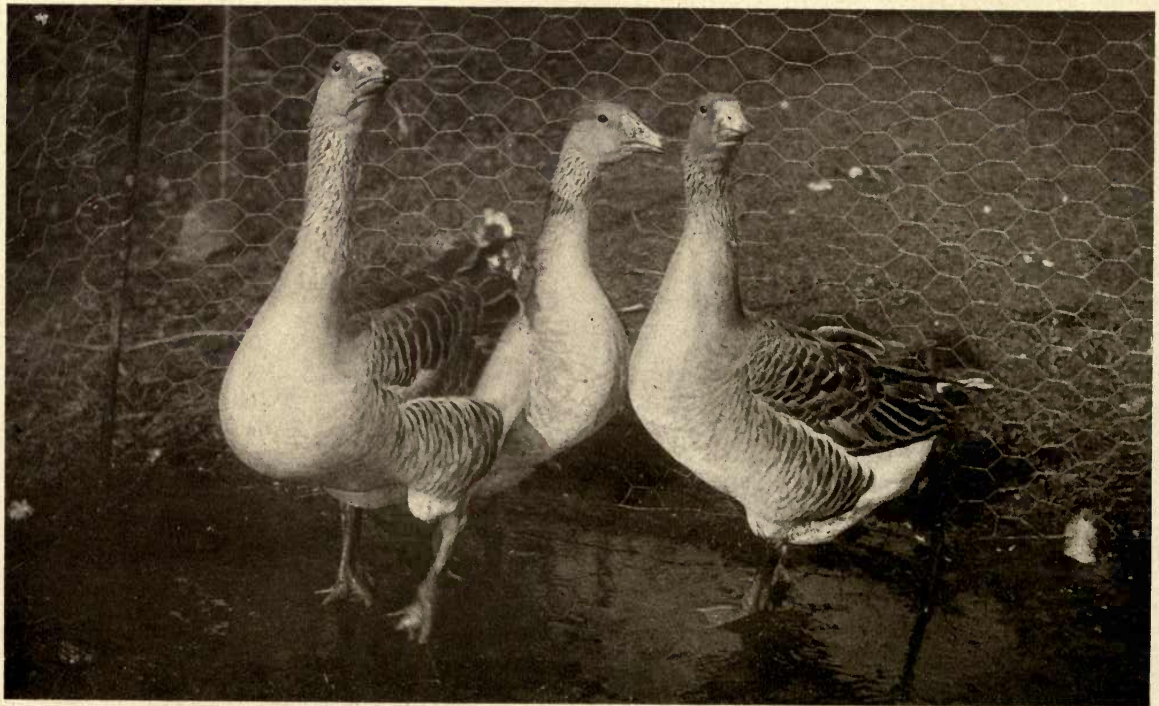

Courtesy of Rhode Island Experiment Station.

CROSS-BRED TOULOUSE-AFRICAN GEESE — EXCELLENT FOR MEAT PRODUCTION.

by removing the eggs from the goose. The eggs may be hatched under hens or in incubators, the period of incubation being from twenty-eight to thirty days or sometimes longer. Goslings require little or no food during the first 24 hours but should have water to drink. It should be remembered that geese, like ducks, have no crop and therefore should be fed at frequent intervals. They should first be allowed to eat green grass and should also receive soaked grain, corn, oat meal or corn meal mixed with sweet skim milk with a little sand added. With young geese green feed is exceedingly important and with either clover or alfalfa pasture they will maintain themselves without any other food unless an attempt is being made to force them to an early maturity. In the production of "green geese" the fattening period should begin when the long wing feathers have grown sufficiently to reach the tail. The geese should be penned up in fairly close quarters and should be fed two or three times daily on a soft mash containing four parts Indian meal, one part beef scraps, slightly salted. During the middle of the day they may receive whole grain, especially if soaked. Toulouse geese crammed by hand for five weeks on one pound of corn meal daily produce a liver which weighs from two and one-half to four pounds. This is an important industry in France and other European countries where the foie gras commands a large price on the market. The feeding period for foie gras lasts about four to six weeks and the birds are fed two or three times daily. In England the preferred ration for this purpose is one and one-half pounds of a mixture of corn and cracked beans per day. According to another system of feeding young goslings they receive the first three days the same

food as ducklings. Then the boiled eggs are omitted from the ration and they are given bread soaked in skim milk, oat meal, boiled rice, onions and grass. A grass run is quite necessary. Water is strictly necessary to drink but not to bathe in until at a slightly later age. If goslings are fattened on a mixture of barley meal and corn meal soaked in buttermilk they should be ready for market at the age of twelve to fourteen weeks.

As already indicated the general consensus of opinion of those who have had the most experience with geese is that the African geese should be given preference in the production of fat goslings for market since they grow faster than any of the other breeds of geese. A large number of crosses have been made between different geese, and some of these crosses, as for example between the Toulouse and African and the Toulouse and China, are even more satisfactory in some respects than the parent breeds.

Geese, like ducks, are comparatively free from serious diseases. The most dangerous trouble is cholera and this occurs as a rule on the premises of goose feeders who keep a large number of geese in relatively close confinement. When cholera breaks out on such farms it runs a rapid course and the mortality is high. In general these troubles may be avoided by feeding the geese in small pens containing only a few birds in each pen. If the disease should break out under such conditions the affected pen may be readily removed far enough away to prevent the spread of the disease. Good sanitation is as necessary in successful raising of geese as with other farm animals.

TURKEYS

It is generally admitted that the domestic turkey came from the wild species of turkey which inhabits North America, Mexico and Central America. The turkey was first taken to Spain between 1518 and 1520 and into England in 1524. From these early importations two breeds have originated in England, namely the Cambridge which closely resembles our Bronze, and the Norfolk which appears to be almost identical with our Black Turkey. The standard breeds of turkeys in the United States are Bronze, Narragansett, Buff, Slate, White and Black. The Bronze most closely approaches the wild turkey in form, size and coloring, while the Narragansett is very similar with more steel gray bands on the wings. The buff, slate, white and black breeds are instantly recognized by the color which gives them their names. The colors are in most instances quite uniform.

In the breeding of turkeys much carelessness has prevailed in allowing too close crosses so that in many instances the vitality and vigour of the stock has been greatly injured. The vigour of the Bronze has been kept from deteriorating and improved by occasional crosses with wild turkeys. For this purpose a considerable number of wild gobblers have been extensively used. In general strict attention should be given in selecting breeding stock to make sure that the males and females are as little related as possible since otherwise an unthrifty condition of the turkey chicks will obtain.

Feeding Turkey Chicks.—After the first few days turkey chicks may be fed on stale bread soaked in milk with the milk mostly squeezed out and with

the addition of hard boiled eggs and finely chopped onions. Cheese curds also give good results. Later on oat meal, rolled oats, stale bread, onion tops, corn meal, middlings, etc., moistened with skim milk with a little black pepper may be fed as the appetite increases. For the first five weeks turkey chicks should be fed four times daily and later three times. By this time they are able to range for their food with the mother turkeys.

While turkey eggs may be hatched under hens, turkeys or incubators, it is common on farms to allow the hen turkey to do her own incubating. The turkey is an excellent sitter and in fact may sometimes be induced to sit the year round, being used in such instances as a natural incubator. They have a tendency to steal their nests and some attention must be given to this point to prevent weasels and other vermin from destroying the eggs.

Turkeys naturally show more wild tendencies than other farm poultry. For this reason they have to be allowed a wider range. At any rate from the age of five weeks to that of fattening in the fall they are perfectly capable of finding their own living if allowed free range. Their food consists of grasshoppers and other insects as well as grain and herbage. When the fattening period begins in the fall it is best not to confine the birds but to allow them free range, merely feeding grain two or three times a day. For this purpose corn is excellent and may be adopted in relatively large quantities since the turkeys themselves will find insects and other material to supply the nitrogenous side of the ration. As a rule wheat and corn are fed in combination and this seems to be as good as any mixture which can be fed for this purpose. Turkeys cannot be confined closely during the

laying period. Wherever this has been tested to determine the effect, it has been found that the health of the hen turkeys is affected and that the fertility of the eggs is greatly diminished. Their roosting place should be as open as possible, simply protecting them against the heavy rains. In fact, on the average farm, turkeys select their own roosts in trees which they prefer and return to the same place every night. They seem not to take any harm from heavy rains which they are frequently subjected to during the summer nights. At any rate, turkeys endure confinement less readily than any other of our domestic fowls, and this is a fortunate circumstance in many respects since a very hardy fowl can be produced in this way with exceedingly small expense for feeding and for labor.

The diseases to which turkeys are susceptible are for the most part the same as those which occur among chickens and may be treated in the same manner. Young turkeys are exceedingly susceptible to diarrhea and in order to prevent this trouble much attention must be given to the sanitary condition of the food. If the trouble breaks out in a mild form the young turkeys may be fed hard-boiled eggs and stale bread thoroughly covered with pepper. In some cases a little sulphuric acid added to the drinking water gives satisfactory results. Blackhead is a contagious disease of turkeys which has been most extensively studied in Rhode Island where it sometimes occurs in serious outbreaks. In this disease the liver is affected, showing peculiar spots under post mortem examination, and in many cases the head becomes discolored, giving rise to the popular name for the disease. This disease is located in the intestines, and like all other intestinal diseases is spread

through the excrement of affected birds. This obviously necessitates the removal of the dead birds at once in order to prevent the spread of the disease among healthy birds.

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